

Université de Genève
Institut Universitaire de Hautes Etudes Internationales

The Monetary Theory of Flexible Exchange Rates: Microeconomic Underpinning and Empirical Study

Thèse

présentée à l'Université de Genève
pour obtenir le grade de docteur ès sciences politiques

par
In-su Kim
— (Corée)

1978
—



PETER LANG

Berne · Francfort/M. · Las Vegas

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INTRODUCTION

Since the devaluation of the U.S. dollar in 1973, greater flexibility in exchange rates of the major industrialized countries has become an important institutional feature of the present international monetary system. At least for the time being, the major industrialized countries do not seem to have any strong intention to fix the external value of their currencies at particular levels. This significant shift in the international monetary system from fixed to flexible rates induced a strong interest in the actual working of the present monetary system and active discussions are taking place on several controversial issues associated with flexible exchange rates, such as the stability of exchange rates and the foreign exchange market, the effect of domestic economic policy, the impact of exchange risks on international trade and finance, etc.

The general interest in the flexible exchange rate system has been further stimulated by the development of a new theoretical approach to flexible exchange rates. This approach, which is termed the asset or portfolio approach, is in contrast to the standard approach in that emphasis is put on the role of asset equilibrium (domestic and foreign) as determining exchange rates. More precisely, exchange rates are viewed as determined by portfolio equilibrium between domestic and foreign assets, in particular domestic and foreign money; and, as distinct from the standard approach, in which exchange rates are viewed as determined by the flow equilibrium between the supply of and demand for foreign exchange, the asset or portfolio approach argues that they are determined by stock equilibrium, and that flows of international payments by and receipts of residents of a country affect them indirectly by changing the stock of foreign assets held by the private sector.

The aim of my thesis is to discuss three problems which arise from the recent development of the portfolio approach.

The first problem is to clarify the theoretical foundation of the portfolio approach to exchange rate determination. Although this problem does not attract particular attention in the current literature in this field, rigorous clarification of its theoretical foundation is necessary and important, since different meanings are often given by different authors in defining the portfolio nature of exchange rate determination and in specifying the major economic determinants of exchange rates. In discussing this problem, I emphasize the importance of exchange rates as one of the determinants of international portfolio diversification, and present the microeconomic underpinning for the determination of exchange rates by applying simple portfolio theory.

The second problem treated in this paper concerns the macroeconomic implications of the portfolio approach. I discuss the impacts of macroeconomic policy and international (real and monetary) disturbances under flexible exchange rates using a macro model based upon the portfolio approach to exchange rate determination. In so doing, I focus my argument on a theoretical problem which attracts the attention of economists working in this field, namely, the impact of monetary policy on exchange rates in the short-run and long-run. In the current literature, interest centers particularly on whether or not an increase in domestic money supply makes the short-run equilibrium exchange rate overshoot the long-run equilibrium rate; and, it is often argued that the short-run equilibrium exchange rate overshoots the long-run equilibrium rate as a result of a monetary expansion. The main aim of the theoretical part of my thesis is to present a different view of the impact of monetary policy on exchange rates; I shall argue that a monetary expansion does not necessarily lead to overshooting given a certain type of expectation hypothesis about the exchange rate.

The third problem is concerned with an empirical question: to what extent is the portfolio approach supported by empirical evidence? To answer this question, I construct a simple econometric model for the

U.S.-Canadian dollar rate in the 1950's and the first half of the 1970's (more precisely, 1971-1976), and estimate it using quarterly data. I show that the empirical study does not reject the importance of monetary factors assumed by the portfolio approach, in particular the importance of the stock of Canadian dollars as the determinant of the U.S.-Canadian dollar rate during the sample periods.

The plan of the thesis is as follows. In chapter 1 I present a brief review of the standard theory of flexible exchange rates and discuss some theoretical issues associated with it. In chapter 2 I sketch the monetary approach to the balance of payments which constitutes an important starting point for the portfolio approach to flexible exchange rates, and present a monetary theory of flexible rates characterized by the quantity theory of money. In chapter 3 I discuss the foundations of the portfolio approach to exchange rate determination, referring to the importance of demand for foreign monetary assets and the role of the exchange rate as determining the yield differential between domestic and foreign monetary assets. In chapter 4 I derive demand functions for domestic and foreign monetary assets using the mean-variance approach to portfolio choice, and present an asset equilibrium condition for exchange rate determination. In chapter 5 I integrate the portfolio equilibrium condition for exchange rate determination derived in chapter 4 into a macro model, and discuss the effect of domestic economic policy and impact of international (real and monetary) disturbances under flexible exchange rates. In the last chapter, I construct an econometric model for the U.S.-Canadian dollar rate-determination and present empirical results together with comments.

I am grateful to Professor A.K. Swoboda, Professor H. Genberg, and Dr. J.-P. Roth for their helpful suggestions and comments on my thesis. Comments on chapter 5 made by Professor Genberg were particularly important in clarifying some ambiguities in the original version of that chapter. I would also like to express my gratitude to Professor T.J. Courchene of the University of Western Ontario for his helpful explanations of the

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CHAPTER I

The Standard Theory of Flexible Exchange Rates

The aim of this chapter is to review the standard theory of flexible exchange rates and point out some theoretical issues associated with it. What is referred to as the standard theory of flexible exchange rates in this paper is that first formulated by J. Robinson, F. Machlup, and G. Haberler, and later further developed by J.E. Meade, S. Laursen and L.A. Metzler, R.A. Mundell, M. Fleming, E. Sohmen, A.O. Krueger, etc.¹ The standard theory thus defined has been concerned with two theoretical problems associated with flexible exchange rates. The first is the economic determinants of the exchange rate. This problem has often been discussed in terms of the determinants and stability of the demand and

1. For the standard theory of flexible exchange rates, see J. Robinson, "The Foreign Exchange," in J. Robinson, Essays in the Theory of Employment (New York: 1937, Part 3, Chapter 1;

F. Machlup, "The Theory of Foreign Exchanges," in H.S. Ellis and L.A. Metzler (eds), Readings in the Theory of International Trade (Blakiston, Philadelphia: 1949);

G. Haberler, "The Market for Foreign Exchange and the Stability of the Balance of Payments: A Theoretical Analysis," Kyklos, Vol. 3 (1949), pp. 193-218;

J.E. Meade, The Theory of International Economic Policy, Vol. 1: The Balance of Payments (Oxford: Oxford University Press, 1951);

S. Laursen and L.A. Metzler, "Flexible Exchange Rates and Theory of Employment," Review of Economics and Statistics, Vol. XXXII (February 1950), pp. 281-299;

R.A. Mundell, International Economics (London: Macmillan, 1968), Chapters 11, 17, and 18;

M. Fleming, "Domestic Financial Policies under Fixed and under Floating Exchange Rates," International Monetary Fund Staff Papers, Vol. 9, No. 3, (1959), pp. 369-379;

E. Sohmen, Flexible Exchange Rates, 2nd edition (Chicago: University of Chicago Press, 1969);

A.O. Krueger, "Impact of Alternative Policies under Varying Exchange Rates," Quarterly Journal of Economics, Vol. LXXIX, No. 2 (May 1965), pp. 195-208.

supply of foreign exchange. The second is the problem of incorporating the foreign exchange market into a macroeconomic framework and analyzing the effects of economic policies and external (real and monetary) disturbances under flexible exchange rates on domestic price, output, etc. This problem has attracted much attention of economists working in this field, in particular in comparing the effects of macroeconomic policies under fixed exchange rates. In what follows, these two problems are discussed in detail, beginning with the economic determinants of the exchange rate and the foreign exchange market, and following with critical remarks on the standard theory of flexible exchange rates.

(1) The Exchange Rate and The Foreign Exchange Market

Suppose a country (home country) opens up to international trade and investment. Suppose also that residents of the home country freely engage in international transactions of goods and assets. In general it would be quite unusual that international payments and receipts brought about by "autonomous" transactions by residents be equal to each other.¹ Payments by residents to foreigners may be larger than receipts by residents from foreigners, or conversely the former may be smaller than the latter. In the first case, the home country faces an international payments' deficit which is accompanied by an excess of purchases over sales of foreign currency by residents, while, in the second case, it faces a payments' surplus accompanied by an excess of sales over purchases of foreign currency by residents.

How the difference between payments and receipts is reconciled will depend crucially upon the type of international monetary system in place. Suppose, for example, that the home country's monetary authority is prepared to purchase or sell, at a certain fixed rate, the same amount of

1. "Autonomous" transactions are defined as those which result from the free and voluntary choices of individual transactors. For this definition, see H.G. Johnson, "Towards a General Theory of the Balance of Payments," International Trade and Economic Growth (George Allen and Unwin), pp. 153-168.

foreign currency as the difference between payments and receipts. In this case, the difference will be reconciled through a change in the stock of international reserves held by the monetary authority without any accompanying variation in the value of the domestic currency. That is, a surplus (deficit) will be absorbed by an increase in official reserve holdings, and a deficit by a decrease in official reserve holdings.

The above argument reveals that the fixity of the value of domestic to foreign currency presupposes the presence of an official monetary authority prepared to use its international reserves as a buffer stock whenever international payments deviate from international receipts. Therefore, once the official monetary authority is no longer committed to absorb the difference between international payments and receipts through the use of its international reserves, the value of the domestic currency will begin to fluctuate; the fluctuation of the exchange rate will continue until the difference is eliminated and the equilibrium exchange rate is reached.

This argument implicitly presents the essence of the standard approach to exchange rate determination which may be termed the balance-of-payments approach to the exchange rate. The exchange rate is regarded as a relative price between domestic and foreign currency, determined by equilibrium between international payments and receipts. This approach argues that in the absence of the commitment by the monetary authority to absorb the difference between international payments and receipts, an excess of payments over receipts, or a deficit, will lower the value of domestic currency, while an excess of receipts over payments, or a surplus, will raise the external value of domestic currency.¹ Noting that international payments and receipts represents the flow values of international transactions undertaken by residents over a given period of time, one can easily see that exchange rate determination in the standard theory is specified in terms of flow equilibrium. Moreover, international payments are defined as the flow demand for foreign exchange and international receipts as the flow supply of foreign exchange, the standard view of the

1. This is nothing else but the dynamic postulate of the foreign exchange market assumed by the standard theory.

exchange rate can be put another way: the exchange rate is a variable determined by flow equilibrium between demand for and supply of foreign exchange; an excess demand for foreign exchange leads to a fall in the value of domestic currency and an excess supply of foreign exchange brings about the opposite change in the value of domestic currency.

The preceding discussion suggests that the economic determinants of the exchange rate are those which affect the supply and demand of foreign exchange. Autonomous international payments and receipts can be classified broadly into two types: those which arise from international transactions of goods and services, and those which arise from international capital transactions. Among them, exports and autonomous capital inflows constitute the major part of international receipts (namely, supply of foreign exchange), and imports and autonomous capital outflows constitute the major part of international payments (namely, demand for foreign exchange). If we assume, as does the standard theory, that the real volume of exports is a function of the terms of trade and foreign real income, the real volume of imports a function of the terms of trade and domestic real income, and net capital flows a function of interest rate differential, then the equilibrium condition of the foreign exchange market will be specified by the following equation:

$$b_t - b_k = 0 \quad , \quad (1)$$

$$b_t \equiv \frac{p}{e} u^* \left(\frac{p}{ep^*}, y^* \right) - p^* u \left(\frac{ep^*}{p}, y \right) \quad (2)$$

$$b_k \equiv v(i^* - i) \quad (3)$$

where

b_t : balance of trade in terms of foreign currency

b_k : capital account: $\frac{dv}{d(i^*-i)} > 0$

(note: in what follows, d stands for partial differential unless a special remark is made)

u : real volume of domestic imports

$$\frac{du}{dq} < 0, \quad \frac{du}{dy} > 0 \quad \text{where } q \equiv \frac{ep^*}{p}$$

u*: real volume of foreign imports

$$\frac{du^*}{dq^*} < 0, \quad \frac{du^*}{dy^*} < 0, \quad \text{where } q^* \equiv \frac{1}{q}$$

e : the exchange rate; price of a unit of foreign currency in terms of domestic currency units

p, p*: domestic and foreign prices

y, y*: domestic and foreign real incomes

i, i*: domestic and foreign interest rates.

Solving equation (1) with respect to the exchange rate, it can easily be seen that the exchange rate depends upon a number of variables such as domestic and foreign prices, real incomes, and interest rates.¹ Given the partial derivatives defined above, the following conclusions can be derived from equation (1): and increase in domestic price brings about a depreciation of the domestic currency by stimulating domestic imports and reducing foreign imports through the relative price effect and thereby deteriorating the balance-of-trade position of the home country, while an increase in foreign price leads to the opposite effect on the exchange rate by improving the balance-of-trade position of the home country; an increase in domestic real income makes the exchange rate depreciate by raising domestic imports and deteriorating the balance of trade, while an increase in foreign real income brings about the opposite effect on the exchange rate by improving the balance of trade of the home country;

1. A more detailed analysis of the foreign exchange market in which the spot rate is simultaneously determined together with the forward rate is presented by S.C. Tsiang, "The Theory of Forward Exchange and Effects of Government Intervention on the Forward Exchange Market," I.M.F. Staff Papers 7, No. 1 (April 1959), pp. 75-106.

finally, an increase (decrease) in the foreign interest rate relative to the domestic interest rate leads to a depreciation (appreciation of the domestic currency by inducing capital outflows from (capital inflows to) the home country.

Given the standard specification of the exchange rate, two questions may be posed: through what mechanism, and under what conditions is equilibrium of the foreign exchange market restored after being disturbed by an exogenous shock? The first question is concerned with the adjustment mechanism of the foreign exchange market, and the second with stability of the foreign exchange market.

The adjustment mechanism at work in the foreign exchange market will vary, depending upon which variables in the equilibrium condition of the foreign exchange market are assumed to be endogenous. It will, however, be convenient for illustration of the basic adjustment mechanism emphasized in the standard theory to start with the simplest partial equilibrium case in which domestic and foreign prices and incomes are treated as exogenous variables, and capital is assumed to be internationally immobile. In this case, the equilibrium condition of the foreign exchange market becomes simply a function of the balance of trade, where the exchange rate is the only endogenous variable.¹

Under those assumptions, suppose that foreign real income falls for some reason and as a result the home country's exports are reduced. Obviously, the fall in exports will lead to a decrease in its international receipts and therefore to a decline in the supply of foreign exchange of the home country. Given the dynamic postulate of the foreign exchange market assumed in the standard theory, the fall in the supply of foreign exchange will lead to a depreciation of the domestic currency by creating an excess demand for foreign exchange. Depreciation of the domestic currency will in turn affect the volume of exports and imports of the home

1. This case corresponds to the elasticity approach to exchange rate determination which was formulated by F. Machlup, op. cit., and G. Haberler, op. cit.

country by changing the terms of trade: the home country's exports will be stimulated through a lowering of their domestic price (in terms of foreign currency) relative to foreign price, and the home country's imports will be reduced through an increase in their prices (in terms of the domestic currency) relative to the domestic price. That is, depreciation of the domestic currency will improve the balance-of-trade position of the home country by diverting foreign and domestic demand away from foreign to domestic goods, and will tend to restore equality between demand for and supply of foreign exchange. Conversely, if the initial exogenous change is an increase in foreign real income, the opposite result will occur: the home country's balance of trade will tend to improve and consequently its currency will appreciate; appreciation of the domestic currency will in turn offset the initial improvement of the balance of trade by diverting foreign and domestic demand away from domestic to foreign goods. This analysis shows that, in the simple partial equilibrium model, it is through the relative price effect (or the substitution effect) induced by a variation of the exchange rate that adjustment of the foreign exchange market is brought about.¹

The preceding discussion reveals that whether equilibrium of the foreign exchange market is effectively restored (namely, whether the foreign exchange market is stable) depends crucially upon the strength of the substitution effect, which is measured in terms of the price elasticities of exports and imports. The stability condition of the foreign exchange market can be formally obtained by assuming the following dynamic postulates:²

$$\frac{de}{dt} = -k \left(\frac{p}{e} u^* \left(\frac{p}{ep^*} \right) - p^* u \left(\frac{ep^*}{p} \right) \right) , \quad (4)$$

where

k : adjustment coefficient: $k > 0$.

1. The adjustment mechanism in this case can alternatively be characterized as the one based upon the "expenditure switching effect". For this terminology, see H.G. Johnson, op. cit. o/o

Equation (4) states that an excess demand for foreign exchange leads to a depreciation of the domestic currency and an excess supply of foreign exchange to an appreciation of the domestic currency. Linearizing equation (4) with respect to $\underline{e}$, we obtain the following stability condition which is known as the elasticity condition in early writings on flexible exchange rates:

$$j + j^* - 1 > 0 \quad , \quad (5)$$

where

$$j \equiv -\left(\frac{du}{dq} \frac{q}{u}\right) : \text{ import elasticity}$$

$$j^* \equiv -\left(\frac{du^*}{dq^*} \frac{q^*}{u^*}\right) : \text{ export elasticity .}$$

Condition (5) shows that for the foreign exchange market to be stable the sum of the export and import elasticities should be larger than unity. Under this condition, equilibrium of the foreign exchange market will always be restored through adjustment of the exchange rate.¹

So far, the analysis of adjustment and stability of the foreign exchange market has been presented in a partial equilibrium framework which is restricted by some strong assumptions such as constant domestic

2. (From page 7). Domestic and foreign incomes are dropped from equation (4) because they are assumed to be exogenous variables.

1. The measurement of price elasticities attracted much attention of economists, in particular, in the 1940's and 50's in relation to the controversy over the effectiveness of devaluation as a balance-of-payments adjustment policy. For an interesting discussion on some difficulties involved in the measurement of price elasticities, see G.H. Orcutt, "Measurement of Price Elasticities in International Trade," Review of Economics and Studies, Vol. XXXII, No. 2 (May 1950), pp. 117-132.

and foreign prices and incomes, no international capital mobility, etc. Because of these assumptions the adjustment mechanism under flexible exchange rates and its stability have been discussed in terms of the behaviour of the foreign exchange market only.¹ However, if these assumptions are relaxed, the analysis of the adjustment mechanism under flexible exchange rates and its stability will naturally become much more complicated. For example, if we assume that domestic income and interest rate are endogenous variables and that capital is internationally mobile, then the adjustment process of the balance of payments will depend not only upon the substitution effect but also upon the effects arising from changes in domestic income and interest rate. Thus, a more complete analysis of the adjustment mechanism under flexible exchange rates and its stability will require a wider analytical framework based upon a macro-economic model rather than the narrow analytical framework based upon the foreign exchange market only. A more detailed discussion on this point is presented in the next section.

(2) The Effects of Macroeconomic Policies and External Disturbances under Flexible Exchange Rates

Discussion in the previous section was focused upon the economic determinants of the exchange rate and the adjustment mechanism of the foreign exchange market. The purpose of this section is to integrate the foreign exchange market into a macroeconomic model in order to analyse some macroeconomic problems under flexible exchange rates such as the effects of monetary and fiscal policy and foreign (real and monetary) disturbances on domestic real income, the balance of trade, etc. Interest in these problems arises from the fact that flexible exchange rates provide a different adjustment mechanism than those under fixed rates and consequently the effects of macroeconomic policies become quite different from those under fixed exchange rates. Analysis in this section will be

1. The words the adjustment mechanism (process) under flexible exchange rates will be given two definitions in what follows. It narrowly means the adjustment mechanism (process) of the balance of payments under flexible exchange rates on the one hand, and broadly that of a macro model as a whole under flexible exchange rates on the other.

carried out using the following macro model, which has become familiar through a number of works in this field:

$$y = z(y, i) + g + (u^*(y^*, \frac{1}{e}) - e u(y, e)) \quad (6)$$

$$m = L(y, i) \quad (7)$$

$$u^*(y^*, \frac{1}{e}) - e u(y, e) - v(i^* - i) = 0 \quad , \quad (8)$$

where

z : real private expenditure (consumption
+ investment) in terms of domestic prices

g : real government expenditure in terms of
domestic prices

L : real demand for money

m : real quantity of money .

Some remarks will be necessary concerning assumptions which are made in the above macro model.¹ First, the model is constructed under Keynesian assumptions: the elasticity of supply of domestic output is infinite at a given domestic price level and real income is an endogenous variable to be determined by the equilibrium condition of the goods market; the domestic interest rate is determined by equilibrium of the money market which reflects the liquidity preference of the private sector. Second, the home country is assumed to be a small country in the sense that it can not affect the foreign interest rate or the world price, and behaves as a price taker. Therefore, the foreign interest rate, world price and real income are regarded as exogenous variables to the home country. Third, domestic and foreign price units are chosen in such a way that both are equal to unity. Therefore, the terms of trade are represented simply by the exchange rate.

1. A similar type of macro model is found in R.A. Mundell, op. cit., M. Fleming, op. cit., E. Sohmen, op. cit., and A.O. Krueger, op. cit.

Under these assumptions, three markets are specified: the goods market, the money market and the foreign exchange market which represents the external equilibrium condition. The equilibrium condition of the goods market is given by equation (6). It shows that effective demand for home goods consists of three components: private expenditure, government expenditure and the balance of trade. Private expenditure is composed of consumption and investment and is a function of real income and the domestic rate of interest: an increase in real income has a positive effect on real private expenditure and an increase in the rate of interest has a negative effect on it.¹ Government expenditure is treated as a policy parameter, and the balance of trade is, as has already been mentioned, assumed to be a function of domestic real income and the terms of trade (namely, the exchange rate in the present case). The

-
1. If real private expenditure is assumed to be a function of domestic nominal income, domestic price, foreign (import) price and the rate of interest, and to be homogenous of degree zero with respect to the first three variables, real private expenditure will depend not only upon real income and the rate of interest but also upon the terms of trade. The effect of a change in the terms of trade on real expenditure was an important theoretical issue in the 1950's and the early 1960's partly because the terms of trade effect provide a channel through which business cycle of one country is transmitted to another under flexible exchange rates and partly because it constitutes an important condition which determines the effectiveness of exchange rate policy under fixed rates. However, the present model is constructed under the assumption that a change in the terms of trade does not affect real expenditure (namely, the terms of trade effect is zero) because of the theoretical difficulty in determining the effect a priori. For theoretical arguments on this issue, see: A.C. Harberger, "Currency Depreciation, Income and the Balance of Trade," Journal of Political Economy, Vol. LVIII (February 1950), pp.47-60; H.G. Johnson, "The Transfer Problem and Exchange Stability," Journal of Political Economy, Vol. LXIV, No. 3 (June 1956), pp. 212-215; S. Laursen and L.A. Metzler, op. cit.;
R.W. Jones, "Depreciation and the Dampening Effect of Income Changes," Review of Economics and Statistics, Vol. 42 (1960), pp.74-80;
R. Komiya, "Monetary Assumptions, Currency Depreciation and the Balance of Trade," Economics Studies Quarterly, Vol. XVII, No. 2 (December 1966), pp. 9-23;
J. Spraos, "Consumers' Behavior and the Conditions for Exchange Stability," Economica, Vol. N.S. 22 (1955), pp. 137-47;
I.F. Pearce, "A Note on Mr. Spraos' Paper," ibid., pp.147-151.

equilibrium condition of the money market is given by equation (7). The supply of money is, under flexible exchange rates, a parameter determined by monetary policy, and the demand for money is assumed to be a positive function of real income and a negative function of the interest rate. Finally, equation (8) represents the equilibrium condition of the foreign exchange market, which has already been discussed in section 1.

Given the three equilibrium conditions, the model determines three endogenous variables (domestic real income, the interest rate and the exchange rate) simultaneously. Obviously, the equilibrium real income, interest rate and exchange rate will depend upon a number of exogenous variables such as foreign real income, price, interest rate, domestic fiscal and monetary policy, etc. The model can be used to analyze several macroeconomic problems associated with flexible exchange rates in a comparative static framework. Before presenting this comparative static analysis, it will be useful to mention some dynamic properties of the above model on adjustment and stability which are generally assumed in the standard theory of flexible exchange rates.

The standard analytical framework of the dynamic adjustment process of the macro model given by equations (6), (7) and (8) is based upon what may be termed stability analysis.¹ The dynamic process through which the system restores new equilibrium after an exogenous shock occurs is usually specified by a set of differential equations characterized by dynamic postulates on the three markets in the model. In consequence, the path toward final equilibrium and the system's stability depend crucially upon what type of dynamic postulate is imposed on each market in the model. The most familiar dynamic postulates used in the standard theory are as follows: an excess demand for domestic goods leads to an increase in real income; an excess demand for money is accompanied by a rise in the

1. For example, see R.A. Mundell, op. cit., chapter 11, pp. 152-176, and chapter 17, pp. 240-250.

interest rate; and an excess demand for foreign exchange brings about a depreciation of home currency. Mathematically, these dynamic postulates will be presented by the following three first order differential equations:

$$\frac{dy}{dt} = k_1 (z(y,i) + g + u^*(y^*, \frac{1}{e}) - e u(y,e) - y) \quad (9)$$

$$\frac{di}{dt} = k_2 (L(y,i) - m) \quad (10)$$

$$\frac{de}{dt} = - k_3 (u^*(y^*, \frac{1}{e}) - e u(y,e) - v(i^*-i)) \quad (11)$$

where

k_1, k_2, k_3 : adjustment coefficients

$$k_1 > 0, k_2 > 0, k_3 > 0 .$$

With the dynamic equations, we can trace how and under what conditions the system can restore equilibrium when there is an exogenous change. The adjustment process and stability condition given by the above system can be regarded as those of flexible exchange rates in a wider macroeconomic framework. To illustrate the adjustment process of the system and of the balance of payment in particular, suppose that the volume of exports of the home country falls because of a decline in foreign real income. Assuming for the time being that capital is internationally immobile, a balance-of-trade deficit brought about by a fall in exports will lead to a depreciation of the domestic currency by creating an excess demand for foreign exchange on the one hand, and to a decline in domestic real income by bringing about an excess supply of domestic goods on the other. Variations in the exchange rate and real income will in turn have repercussions on the balance of trade of the home country. On the one hand, depreciation of the domestic currency will divert foreign and domestic demand away from foreign to domestic goods. Thus, if the sum of the import and export elasticities is larger than unity, the initial

deficit will be partly offset by the substitution effect. On the other hand, the decline in real income will also improve the balance-of-trade position of the home country by lowering the volume of exports. Thus, the substitution effect induced by a depreciation of the exchange rate and the income effect induced by a decline in effective demand combine to bring the balance of trade back to equilibrium.

If the assumption that capital is not internationally mobile is relaxed, the domestic interest rate also comes into the picture as another variable which affects adjustment of the balance of payments. In the preceding analysis, it was pointed out that an exogenous decline in exports leads to a decrease in real income by reducing effective demand for domestic goods. Given equation (7), the decline in real income will in turn lead to a fall in the domestic interest rate by creating an excess supply of money. As the capital account is specified as a function of the interest rate differential, a fall in the domestic interest rate will induce a capital outflow from the home country, making the deficit of the balance of payments larger and consequently lowering the value of the domestic currency even more. A further depreciation of the domestic currency due to a capital outflow will strengthen the substitution effect and accelerate adjustment of the balance of trade. Given the specification of the capital flow function in the standard theory, the higher is the elasticity of capital flows with respect to a change in interest rate differential, the larger will be the effect of capital flows on the exchange rate and the balance of trade.¹

The preceding discussion reveals that a change in an exogenous variable induces a change in all endogenous variables (the exchange rate, real income and interest rate) and adjustment of the balance of payments under flexible exchange rates takes place through adjustment of all these endogenous variables. Although the substitution effect still plays a

1. Perfect capital mobility is defined as the case where the elasticity of capital flows with respect to interest rate differential is infinite. See R.A. Mundell, op. cit.

major role in bringing about equilibrium under flexible exchange rates, real income and capital movements also become important factors in the adjustment process. The system will be stable as long as it fulfills the following conditions which are obtained by linearizing equations (9), (10) and (11) and solving the set of first order differential equations with respect to real income, the rate of interest and the exchange rate.¹

$$1 - \frac{dz}{dy} + \frac{du}{dy} > 0, \text{ and } j + j^* - 1 > 0 \quad (12)$$

In words, for the system to be stable, two conditions are required: one is that the marginal propensity to absorb (private) be smaller than 1 plus the marginal propensity to import, and the other that the sum of the import and export elasticities be larger than unity.

Let us turn to the comparative static analysis of the effects of fiscal and monetary policy and foreign disturbances under flexible exchange rates. To facilitate analysis, we assume for the time being that capital is not internationally mobile. As for fiscal and monetary policy, we can conclude that they are quite effective in stimulating domestic real income.² An expansion of government expenditure will directly increase effective demand and bring about an increase in real income, although part of the expansion effect will be offset by an increase in the domestic interest rate. Similarly, an increase in money supply will stimulate effective demand and therefore real income by lowering the domestic interest rate. In both cases the exchange rate will depreciate

1. In deriving the stability conditions, it is assumed that other partial derivatives have normal signs, as was the case in the preceding discussion.

2. Under the assumption of capital immobility, equations (6) (7) and (8) can be rewritten as follows:

$$y = z(y, i) + g \quad (6')$$

$$m = L(y, i) \quad (7')$$

$$u^*(y^*, \frac{1}{e}) - e u(y, e) = 0 \quad (8')$$

(continued)

as compared with its initial level, but without any effect on effective demand, since the terms of trade effect is assumed to be zero on the one hand, and the balance of trade is also equal to zero because of the assumption of capital immobility on the other.

What effect does international real disturbance have on domestic real income and the exchange rate? We can show that, as distinct from fixed exchange rates, flexible exchange rates provide a strong insulation effect in the sense that a fluctuation in foreign income is not transmitted to the home country. To illustrate this point, we again suppose that the home country's exports fall because of a recession in the foreign country. Under flexible exchange rates the fall in exports will not have an effect on the home country's real income. Due to the assumption of capital immobility, its balance of trade is always equal to zero and therefore can not affect effective demand. Consequently, real income of the home country is determined independently of its balance-of-trade position and a decrease in exports will only bring about a variation in the exchange rate.¹ (For footnote 1, see overleaf)

Differentiating equations (6'), (7') and (8') with respect to g , and solving them with respect to (dy/dg) we obtain the following result:

$$\frac{dy}{dg} = \frac{L_i}{(1-z_y)L_i + z_i L_y} > 0 .$$

Similarly, differentiating the three equations with respect to money supply and solving them with respect to (dy/dm) we have:

$$\frac{dy}{dm} = \frac{z_i}{(1-z_y)L_i + z_i L_y} > 0 ,$$

where

$$L_y \equiv \frac{dL}{dy} , \quad L_i \equiv \frac{dL}{di} , \quad z_y \equiv \frac{dz}{dy} , \quad z_i \equiv \frac{dz}{di} \quad \text{etc.}$$

Note, $L_y > 0$, $L_i < 0$, $z_y > 0$, $z_i < 0$.

Now we relax the assumption that capital is internationally immobile. This leads to some interesting modifications of the preceding analysis because the balance-of-trade position and therefore effective demand of the home country come to depend significantly upon the degree of capital mobility which is represented by the elasticity of capital flows with respect to a change in interest rate differential. In particular, if we assume that capital is perfectly mobile (i.e. infinitely elastic with respect to changes in the rate of interest) we obtain the following important results.¹

First, in contrast to the case of capital immobility, fiscal policy loses its effectiveness as a stabilization policy.² An increase in government expenditure will tend to stimulate effective demand directly and raise real income. Consequently, the domestic interest rate will rise relative to the foreign interest rate, which will in turn induce a capital inflow to the home country. Under the assumption of perfect capital mobility, this capital inflow will cause the domestic currency to appreciate to the level at which the home country has a trade deficit just

1. (ref: page 16) This point is easily seen from equations (6'), (7') and (8').

1. For a pioneering work on this problem, see R.A. Mundell, op. cit.

2. Differentiating equations (6), (7) and (8) with respect to government expenditure and solving them with respect to (dy/dg) , we obtain the following result:

$$\frac{dy}{dg} = \frac{L_i}{(1-z_y)L_i + z_i L_y - v_x L_y} \quad (\text{where, } x \equiv i^* - i) .$$

Assuming v_x is infinity, (dy/dg) becomes equal to zero, since

$$\frac{dy}{dg} = \frac{L_i / v_x}{((1-z_y)L_i + z_i L_y) / v_x - L_y} \rightarrow 0, \text{ when } v_x \text{ is infinite.}$$

offsetting the initial increase in government expenditure, pulling down effective demand to the initial level. As a result, fiscal policy cannot have any effect on real income.¹

Second, in contrast to fiscal policy, monetary policy in this situation is quite effective as a stabilization tool.² An increase in money will lower the domestic interest rate by bringing about an excess supply of domestic money. The fall in the domestic interest rate will induce a capital outflow, which makes the domestic currency depreciate. In the case of perfect capital mobility, the domestic currency will depreciate to the level at which a trade surplus is generated by the same amount as the initial capital outflow. Consequently, the trade surplus stimulates effective demand and results in an increase in real income. Thus, monetary policy has a strong effect on real income through its effect on the rate of interest and capital movements when capital movements are very sensitive to a change in the interest rate differential.³

1. It is interesting to compare this result with the one which is obtained in the case of fixed exchange rates. Given the assumption of perfect capital mobility, fiscal policy becomes effective as an income stabilization policy under fixed exchange rates. For this point, see R.A. Mundell, op. cit.

2. Differentiating equations (6), (7) and (8) with respect to money supply and solving them with respect to (dy/dm) , we obtain:

$$\frac{dy}{dm} = \frac{z_i - v_x}{((1-z_y)L_i + z_i L_y) - v_x L_y} = \frac{z_i/v_x - 1}{((1-z_y)L_i + z_i L_y)/v_x - L_y}.$$

Therefore, if v_x is infinite, (dy/dm) is equal to $1/L_y$. It is easily seen from this result that monetary policy is quite effective in stimulating real income under flexible exchange rates.

3. In contrast to the case of flexible exchange rates, monetary policy does not have any effect on real income under fixed exchange rates when capital is perfectly mobile. For this point, see R.A. Mundell, op. cit.

Third, flexible exchange rates can still insulate the domestic economy from a fluctuation in foreign real income in the case of perfect capital mobility.¹ Again, suppose that foreign real income falls for some reason and the home country's exports decline. In the case of perfect capital mobility, this decline of exports cannot offset real income of the home country for two reasons. First, the trade deficit caused by the decline in foreign real income will immediately lead to a depreciation of the domestic currency which will partially weaken the initial impact of the trade deficit on effective demand by diverting both foreign and domestic demand to domestic goods. Second, a fall in the domestic interest rate brought about by a decrease in real income due to the trade deficit will lead to a further depreciation of the domestic currency by inducing a capital outflow from the home country. Given the assumption of perfect capital mobility, a deficit of the capital account thus induced will perfectly offset the initial decrease in effective demand by generating a trade surplus by the same amount as the initial trade deficit. Consequently, real income, the exchange rate, and the domestic interest rate will remain unchanged in the new equilibrium situation.²

1. The effect of a fall in foreign income on domestic real income can be obtained by differentiating equations (6), (7) and (8) with respect to y^* and solving them with respect to (dy/dy^*) .

$$\frac{dy}{dy^*} = \frac{-L_i}{((1-z_y)L_i + z_i L_y) - v_x L_y} = \frac{-L_i/v_x}{((1-z_y)L_i + z_i L_y)/v_x - L_y}.$$

Assuming that v_x is equal to infinity, (dy/dy^*) becomes equal to zero since $L_i/v_x = 0$.

2. This can be intuitively understood by referring to footnote (1) on this page. It shows that a change in y^* does not affect y . Thus, given the equilibrium condition of the money market, y^* cannot affect the domestic interest rate. This in turn means that the exchange remains unchanged in the new equilibrium situation.

(3) Critical Remarks on the Standard Theory

Sections (1) and (2) presented a review of the standard theory of flexible exchange rates. The review emphasized the following main points of the standard approach.

(a) External equilibrium was defined as the flow equilibrium between the demand for and the supply of foreign exchange. It was determined by components of international credits and debits, such as imports, exports, capital transactions, etc. The exchange rate was thus viewed as a variable determined by the flow equilibrium between demand for and supply of foreign exchange arising from those international transactions.

(b) The exchange rate was regarded as inducing adjustment of international payments through its effect on the relative price between domestic and foreign goods. Consequently, the stability of the foreign exchange markets depended significantly upon the size of the price elasticity of exports and imports.

(c) Capital movements were introduced as a flow function of interest rate differentials between two countries.

Given the definition of the external equilibrium condition, the specification of external equilibrium in the case of perfect capital mobility implies that a "recursive" relation exists between the balance of trade and the capital account: the balance-of-trade position of a country is essentially determined by the size of its capital account.¹

1. In the small country case, the domestic interest rate can not deviate from the foreign interest rate under perfect capital mobility. Thus a small change in the domestic interest rate induces a large change in capital flows so that the domestic interest rate is prevented from deviating from the foreign interest rate, and consequently the balance-of-trade position is entirely determined by the capital account. If capital is less than perfectly mobile, however, the domestic interest rate can deviate from the foreign interest rate and the recursive relation does not necessarily hold.

For example, a capital outflow from the home country brings about a trade surplus by inducing a depreciation of its currency. Consequently, economic policies, such as monetary policy, which can have a strong impact on the capital account through their effects on the domestic interest rate become quite effective as an income-stimulating policy since they can affect the balance of trade and thereby effective demand by changing the size and direction of capital flows.

Given the above features of the standard theory, we can now discuss two theoretical issues associated with it, namely, the specification of the capital movements function and the partial equilibrium nature of the specification of external equilibrium.

(1) As already seen, the standard theory specifies international capital movements using a flow function of interest differentials between countries. This approach to capital movements may be criticized as incomplete in that it fails to recognize the portfolio-adjustment nature of international capital movements. The application of the theory of portfolio choice to international assets diversification suggests that the composition of individual investors' desired portfolios as between domestic and foreign assets is represented by a stock function which depends upon a number of variables such as rates of return, risk, the stocks of wealth, etc. Any divergence between actual and desired portfolios thus determined will induce investors to readjust their portfolios, which eventually appear as international flows of assets. This means that flows of international capital can be regarded as reflecting individual investors' portfolio adjustments across national borders, induced by changes in those variables mentioned above.¹

1. For the portfolio theory of assets demand, see

H. Markowitz, Portfolio Selection: Efficient Diversification of Investments, (New York, Wiley 1959);

J. Tobin, "Liquidity Preference as Behaviour towards Risk," Review of Economic Studies, Vol. 25, No. 67 (February 1958), pp.65-86.

(continued)

Under the portfolio view of international capital movements, observed capital flows may be divided into two components, depending upon whether or not a distinction is made between the static and dynamic cases. In the static case, where the stocks of wealth held by the private sectors at home and abroad are assumed constant, flows of international capital will be regarded as a consequence of once-and-for-all change in international portfolio diversification, induced by changes in the determinants of portfolio equilibrium.¹ This type of capital flow, which may be generally termed "stock-adjustment component" of capital movements, will only have a temporary effect on the capital account of a country and will cease once desired portfolios are attained.

For some works on international capital movements which are based upon the portfolio approach, see

H.G. Grubel, "Internationally Diversified Portfolios: Welfare Gains and Capital Flows," American Economic Review, Vol. 58, No. 4 (December 1968), pp. 1299-1314;

C.H. Lee, "A Stock Adjustment Analysis of Capital Movements: The United States-Canadian Case," Journal of Political Economy, Vol. 77, No. 4 (July/August 1969), pp. 512-523;

N.C. Miller and M.v.N. Whitman, "A Mean-Variance Analysis of United States Long-Term Portfolio Foreign Investment," Quarterly Journal of Economics, Vol. 84, No. 2 (May 1970), pp. 175-96;

T.D. Willett and F. Forte, "Interest Rate Policy and External Balance," Quarterly Journal of Economics, Vol. 83, No. 2 (May 1969), pp. 242-262.

1. The importance of the analytical distinction between the two components of capital flows in what follows is emphasized by a number of economists. For example, see

W.H. Branson, "Macroeconomic Equilibrium with Portfolio Balance in Open Economies," Seminar Paper, No. 22, Institute for International Economic Studies, University of Stockholm, 1972;

H.G. Grubel, op. cit.;

J.E. Floyd (1), "International Capital Movements and Monetary Equilibrium," American Economic Review, Vol. LIX, No. 4 (September 1969), pp. 472-492;

J.E. Floyd (2), "Monetary and Fiscal Policy in a World of Capital Mobility," Review of Economic Studies, Vol. IIIVI (4) (October 1969), pp. 503-517;

T.D. Willett and F. Forte, op. cit.;

N.C. Miller and M.v.N. Whitman, op. cit.

On the other hand, if the analysis is extended to the dynamic case, where the stocks of wealth are increasing over time, capital flows will be regarded as being composed of not only those which are induced by a once-and-for-all portfolio adjustment but also those which are induced by a continuous increase in the stocks of wealth. The latter component of capital flows, termed the "flow-adjustment component", is caused by new savings which seek profitable uses under given rates of return and risks on domestic and foreign assets. Thus, this component of capital flows will exist even if there are no interest rate differentials between two countries, and continuously affects the capital account of a country as long as the rate of change in wealth accumulation is not equal to zero.¹

1. The above argument can be presented by the use of the assets demand function. Suppose that $A = A(i, i^*, r, r^*, W)$ represents the home country's demand for foreign assets and $A^* = A^*(i, i^*, r, r^*, W^*)$ the foreign country's demand for home assets, in which i and i^* stand for the rates of return on domestic and foreign assets, respectively, r and r^* for risks on domestic and foreign assets, and W and W^* for the stocks of domestic and foreign wealth. (Note that the demand functions are specified in terms of stocks.) Then, net capital inflows to the home country, namely (dK/dt) , will be given by:

$$\begin{aligned} \frac{dK}{dt} = & \left(\frac{dA^*}{di} - \frac{dA}{di} \right) \frac{di}{dt} + \left(\frac{dA^*}{di^*} - \frac{dA}{di^*} \right) \frac{di^*}{dt} + \left(\frac{dA^*}{dr} - \frac{dA}{dr} \right) \frac{dr}{dt} + \left(\frac{dA^*}{dr^*} - \frac{dA}{dr^*} \right) \frac{dr^*}{dt} \\ & + \left(\frac{dA^* dW^*}{dW^* dt} - \frac{dA dW}{dW dt} \right) \end{aligned} \quad (i)$$

The first four terms represent the stock-adjustment component of international capital flows, while the last term represents the flow-adjustment component of international capital flows. Using W.H. Branson's terminology, capital flows represented by the first four terms correspond to those which are induced by the "stock shift" effects on short-run (portfolio) equilibrium and capital flows represented by the last term to those which are induced by the "continuing-flow" effects on long-run (portfolio) equilibrium. For this point, see W.H. Branson, op. cit. For the terminology on stock and flow-adjustments, see N.C. Miller and M.v.N. Whitman, op. cit.

The preceding discussion of the portfolio approach to international capital movements suggests that the standard specification of the capital movements function suffers from certain limitations. If the standard model is concerned with capital movements in the static case, the capital flow function is not relevant since it fails to take into account the temporary nature of capital movements. As noted, capital flows in the static case reflect a once-and-for-all portfolio adjustment and will cease once new portfolio equilibrium has been attained; that is, the potential effect of capital movements on the balance of trade and the exchange rate will be temporary and will not persist once equilibrium is attained. The proper specification of the capital movements function in equilibrium, therefore, requires the capital account to be equal to zero, and the external equilibrium condition is that of a zero balance of trade.¹ Thus, the standard specification of the external equilibrium condition will be subject to some modification in order to allow for the temporary nature of the stock adjustment effect.

On the other hand, if we consider the external equilibrium condition in the dynamic case, a more careful formulation will be needed to relate wealth accumulation (or saving) to international capital movements. The size and direction of the flow-adjustment component, which constitutes an important part of observed capital flows, depends to a large extent upon new savings which seek profitable uses internationally. This means that we need a more rigorous theoretical framework for this type of capital movement which will enable us to analyze the effect of a continuous change in the stock of wealth brought about by new savings on international diversification of portfolios by the private sector at home and abroad.²

1. This temporary nature of the stock-adjustment component of international capital movements is mentioned in particular by J.E. Floyd (1) and (2), op. cit.

2. A specification of the capital flow function based upon the portfolio approach leads to an interesting view which contradicts the standard recursive relation between the balance of trade and the capital account:

(continued)

The aforementioned remarks suggest that the standard capital movements function must be modified in order to capture the impact of international assets transactions on the exchange rate, the balance of trade, etc. The necessity for this modification will be greater, the more important is the role of international assets transactions in determining the exchange rate and the effects of macroeconomic policies under flexible exchange rates. This implies that the preceding theoretical conclusions on the determination of the exchange rate, the adjustment process and the effects of economic policies and external disturbances should carefully be re-examined under a modified specification of the capital movements function, since they depend significantly upon the standard specification of international capital flows.

(2) The standard theory fails to recognize the monetary nature of balance-of-payments disequilibrium. As already seen, the external equilibrium condition is given in the standard theory by the flow equilibrium of the demand for and supply of foreign exchange which depends upon specific items in international payments such as imports, exports, capital transactions, etc. This sectoral approach to the balance of payments consequently regards those specific items as the major determinants of exchange rate fluctuations.

It is important to note that this approach fails to view the balance of payments in a general equilibrium context where money is explicitly included. Defining the balance of payments as the rate of change in international reserves held by the monetary authority of a country, the standard approach overlooks that the balance of payments corresponds, in a general equilibrium framework, to the private sector's flow excess demand for domestic money; that is, disequilibrium of the balance of

the capital account position of one country is determined by its balance of trade position, and not the other way around. For this view, see P.J.K. Kouri "The Exchange Rate and the Balance of Payments in the Short-run and in the Long-run: A Monetary Approach," presented at the Seminar on Flexible Exchange Rates and Stabilization Policy, Stockholm (Aug.1975).

payments reflects a flow disequilibrium between the demand for and supply of domestic money.¹ This monetary view of the balance of payments has several important implications for the theory of flexible exchange rates.

First, it suggests that the exchange rate will continuously fluctuate under flexible exchange rates as long as there exists disequilibrium between the flow demand for and supply of domestic money; external equilibrium will not be attained unless the excess demand for domestic money is equal to zero. This suggests that the domestic monetary condition, in particular the quantity of domestic money, constitutes a crucial determinant of the equilibrium exchange rate under flexible exchange rates.

Second, the monetary approach also introduces another adjustment mechanism under flexible exchange rates which is not necessarily elaborated in full by the standard approach. According to the standard approach, the main adjustment mechanism under flexible exchange rates works through the substitution effect: a change in the exchange rate leads to a change in relative prices as between domestic and foreign goods, which in turn brings about adjustment in exports and imports by switching demand from one national good to another. However, if the balance of payments is regarded as reflecting the flow excess demand for domestic money, it may be argued that external equilibrium can be restored if a change in the exchange rate leads to a change in the real quantity of domestic money and makes the flow excess demand for money equal to zero; that is, the main adjustment mechanism under flexible exchange rates in that case will work through the real cash balance effect which is brought about by a change in the exchange rate on the domestic money supply.

1. For this point, see H.G. Johnson, op. cit.; R.A. Mundell, "Barter Theory and the Monetary Mechanism of Adjustment," in R.A. Mundell, op. cit., chapter 8, pp. 111-133; R. Komiya, "Economic Growth and the Balance of Payments: A Monetary Approach," Journal of Political Economy, Vol. 77, No. 1 (January/February 1969), pp. 35-48.

Third, as the preceding argument implicitly reveals, stability of adjustment under flexible exchange rates may not crucially depend on the elasticity condition emphasized by the standard approach. Instead, stability will depend upon the extent to which a change in the exchange rate can affect the real quantity of domestic money and the impact which expectations on the future exchange rate may have on the demand for money.

The foregoing critical remarks on the standard theory of flexible exchange rates suggest that the standard theory does not properly capture the role of certain monetary factors under flexible exchange rates such as international capital movements and the demand and supply of domestic money. It fails to treat international capital movements from the point of view of portfolio imbalance and thus fails to correctly capture the impact of portfolio adjustment on the exchange rate, the balance of trade, etc. It also fails to realize that the demand for and supply of domestic money is an important economic factor in the determination of the exchange rate and adjustment under flexible exchange rates; what the standard theory is mainly concerned with is the impacts of real factors such as relative prices and real income on determination of the exchange rate and adjustment under flexible exchange rates. These arguments suggest that the need for an alternative theoretical approach to flexible exchange rates in which monetary factors are properly integrated is quite great. The importance of monetary factors is continually increasing, partly because the rapid development of international money and capital markets has come to have stronger impacts on the determination of the external value of national currencies by inducing more frequent international movements of money and capital, and partly because it has come to be widely recognized that the impact of domestic monetary disturbances on the payments position of a country is quite significant.

It is these considerations that underlie the interest of this paper in the roles of monetary factors under a system of flexible exchange rates. The main purpose of this paper is to extend the standard model by

more completely incorporating monetary factors. In particular, the discussion will center on the theoretical and empirical implications of (short-term) assets diversification for exchange rate determination and adjustment under flexible exchange rates. In other words, the main effort of the present paper will be that of incorporating portfolio theory into the theory of flexible exchange rates.

In the next chapter I present a simple monetary theory of the balance of payments, which constitutes an important starting point for the monetary theory of flexible exchange rates, and then extend it to a long-run monetary theory of flexible exchange rates.

CHAPTER II

The Monetary Approach to

Balance-of-Payments Theory

In this chapter, I shall first present a brief review of the monetary approach to the balance of payments using a simple macro model and later make reference to the monetary approach to flexible exchange rates based upon the quantity theory of money.¹ The review will be useful and necessary since the monetary theory of flexible exchange rates is essentially a direct theoretical development of the monetary approach to balance-of-payments theory.

1. For the monetary approach to the balance of payments see:

H.G. Johnson (1), "Towards a General Theory of the Balance of Payments," International Trade and Economic Growth (London: Allen and Unwin, 1958), pp. 153-168;

H.G. Johnson (2), "The Monetary Approach to Balance-of-Payments Theory," in M.B. Connolly and A.K. Swoboda (eds), International Trade and Money (London: Allen and Unwin, 1972), chapter 11, pp. 206-224;

R.A. Mundell (1), "Barter Theory and the Monetary Mechanism of Adjustment," in R.A. Mundell, International Economics (New York, 1968), chapter 8, pp.111-133;

R.A. Mundell (2), "The International Disequilibrium System," ibid., chapter 15, pp. 217-232;

R. Komiya, "Economic Growth and the Balance of Payments: A Monetary Approach," Journal of Political Economy, Vol. 77, No. 1 (January/February 1969), pp. 35-48;

A.K. Swoboda (1), "Equilibrium, Quasi-Equilibrium, and Macroeconomic Policy under Fixed Exchange Rates," Quarterly Journal of Economics, Vol. LXXXVI (February 1972), pp. 162-171;

A.K. Swoboda (2), "Monetary Policy under Fixed Exchange Rates: Effectiveness, the Speed of Adjustment and Proper Use," Economica, (May 1973), pp. 205-223;

R. Dornbush, "Real and Monetary Aspects of the Effects of Exchange Rate Change," Discussion Paper No. 72-16, Dept. of Economics, University of Rochester, 1972;

M. Mussa, "A Monetary Approach to Balance-of-Payments Analysis," Journal of Money, Credit and Banking, Vol. VI, No. 3 (Aug 1974), pp.333-350:

(continued)

(1) The Model

The monetary approach to the balance of payments, which has been advocated by a number of economists, is a modern elaboration of the classical theory of the balance of payments characterized by the specie-flow mechanism.¹ The essence of the monetary approach is to view the balance of payments as a monetary phenomenon in the sense that its disequilibrium reflects a dynamic monetary adjustment arising from imbalances between the demand and supply of domestic money. This monetary view of the balance of payments is based upon two theoretical considerations. First, the balance of payments, defined as the rate of change in international reserves held by the monetary authorities of one country, is specified in a general equilibrium framework where money is included as one of the major macro variables and is viewed as a relation between the values of the country's output (or national income) and its total expenditure rather than a relation between international credits and debits on the international account.² In consequence, emphasis is put on the general equilibrium relation between the balance of payments and demand for domestic money: a balance-of-payments surplus corresponds to a flow excess demand for domestic money and a balance-of-payments deficit

J.A. Frenkel and C.A. Rodriguez, "Portfolio Approach and the Balance of Payments," American Economic Review, Vol. 65 No. 4 (September 1975), pp. 674-687.

For a survey of the analytical framework of monetary approaches to the balance of payments, see A.K. Swoboda (3), "Monetary Approaches to Balance-of-Payments Theory: Framework for a Survey," The Graduate Institute of International Studies, Geneva, 1974.

1. For the classical theory of the balance of payments, see D.Hume, "Of the Balance of Trade," in R.N. Cooper (ed.), Readings in International Finance (Penguin Books, 1969), chapter 1, pp. 25-37. The theoretical differences between the classical and modern monetary approaches is discussed in detail by H.G. Johnson (2), op. cit.

2. The economic implications of the absorption approach for the monetary approach is discussed by H.G. Johnson (1), op. cit. And, for the absorption approach, see S. Alexander, "The Effects of a Devaluation on a Trade Balance," I.M.F. Staff Papers, Vol. 2, No. 2 pp.263-278.

to a flow excess supply of domestic money. Thus, disequilibrium of the balance of payments is regarded as disequilibrium of the flow demand and supply of domestic money.¹ Second, special attention is paid to the empirical finding that the demand for money is quite stable, especially in the long-run, with respect to a number of variables such as real income, price, the rate of interest, etc.² Thus, strong emphasis is placed on the importance of monetary factors, in particular on the quantity of domestic money, as determinants of the balance of payments by viewing the balance of payments as reflecting the monetary adjustment caused by divergences between the actual and desired stocks of domestic money.

A more detailed presentation of the theoretical structure of the monetary approach will be facilitated by the use of a simple macro model characterized by the following assumptions:

- (i) the country (home country) is in full employment and produces only the Hicksian composite goods which are internationally tradable,³
- (ii) the home country is small in the sense that it can not affect the foreign price of traded goods and behaves as a price taker,
- (iii) the home country's economy is in the stationary state so that there is neither real capital accumulation nor growth of the labour force,

1. For this point, see R.A. Mundell (1), op. cit.; R. Komiya, op. cit.

2. For the theoretical discussion on stability of demand for money, see M. Friedman, "The Quantity Theory of Money: A Restatement," in M. Friedman (ed.), Studies in the Quantity Theory of Money (Chicago: Chicago University Press, 1953).

3. For the concept of the Hicksian composite goods, see J.R. Hicks, Value and Capital, Clarendon Press, (1939). The reason for excluding non-traded goods from the analysis is to avoid complexities arising from real effects brought about by changes in relative prices between traded and non-traded goods. For a two-good model which takes into account real effects, see R. Dornbush, op. cit.

(iv) there are no international assets transactions and only one sort of financial asset, domestic money, is available as a means for wealth accumulation.

Given these assumptions, we first note that in the present model the domestic price of the home country becomes an exogenous variable, since the home country produces only traded goods, the prices of which are exogenously determined by the foreign country due to the small-country assumption. Thus, denoting the exchange rate by $\underline{e}$, we specify the equation for the domestic price as follows:

$$p = ep^* , \quad (1)$$

where

e : exchange rate: price of a unit of foreign currency in terms of home currency units

p : domestic price of the home country

p^* : foreign price of composite traded goods.

Assuming that the exchange rate is fixed at unity, then the home country's domestic price level is simply equal to the foreign price level, namely,

$$p = p^* . \quad (2)$$

Next, we specify the budget constraint of the home country which plays an important role in relating the flow commodity equilibrium condition to flow wealth accumulation. We assume that the home country is disaggregated into the private and government sectors only. Then the budget constraint of the home country as a whole is obtained by adding the two sectors' budget constraints. The private sector's budget constraint is given by equation (3), if we assume that the private sector, which earns nominal income $\underline{Y}$ and pays nominal tax $\underline{T}$, spends part of its disposable income on goods and saves the rest of it.

$$\underline{Y} - \underline{T} \equiv Z_p + H , \quad (3)$$

where

Y: nominal income of the private sector

T: nominal tax paid by the private sector to the government sector

Z_p : nominal expenditure of the private sector

H: nominal savings of the private sector.

On the other hand, if we assume that the government sector purchases goods Z_g and finances its expenditure through its tax revenue alone, then the budget constraint of the government sector is given by:

$$T \equiv Z_g, \quad (4)$$

where

Z_g : nominal government expenditure.

Adding equation (3) to (4), the budget constraint of the home country as a whole is specified by:

$$Y \equiv Z + H, \quad (5)$$

where

$Z \equiv Z_p + Z_g$: aggregate nominal expenditure (or absorption).

Rewriting equation (5) in real terms, it becomes:

$$y \equiv z + h, \quad (6)$$

where

y: real income (real output) of the home country

z: real aggregate expenditure (absorption) of the home country

$$z \equiv z_p + z_g$$

h: real savings by the private sector.

The aggregate budget constraint indicates that an excess of expenditure over income is financed through dissaving on the part of the private sector and an excess of income over expenditure represents savings. The accumulation of domestic money is the only form of wealth accumulation in the present model because of the assumption that domestic money is the only asset held by the private sector. Thus, a difference between income and expenditure represents a hoarding (or dishoarding).

Let us turn to the specification of the goods market. Given the assumption that the home country is in full employment, the aggregate supply of goods produced by the home country is perfectly inelastic at a given level. On the other hand, the real aggregate demand for goods is equal to the sum of the private and the government sectors' expenditure and the balance of trade. Thus, the equilibrium condition of the goods market will be specified as follows:

$$y = z_p + z_g + b_t, \quad (7)$$

where

b_t : balance of trade of the home country in real terms.

The specification of the goods market equilibrium condition is not complete unless the expenditure function in equation (7) is specified. Given the assumption that government expenditure is a policy parameter, domestic absorption depends upon the private sector's expenditure. Using the private sector's budget constraint, we can specify its expenditure indirectly by specifying its savings decision, since the private sector's budget constraint indicates that the part of disposable income not spent on goods represents saving. In specifying the savings function of the private sector, I assume that saving reflects a stock adjustment of wealth by the private sector. More precisely, I assume that the private sector's saving is a function of the difference between desired and actual wealth stocks¹; that is, the private sector accumulates money when its

actual stock of wealth is lower than its desired level and reduces it when its actual stock is higher than its desired level. Neither saving nor dissaving occurs if there is no divergence between them. This theoretical approach requires that we specify the economic determinants of the desired level of the stock of wealth. In the present case, where accumulation of wealth is made only in (domestic) money, the desired level of wealth can be represented by the stock demand for domestic money. Thus, assuming that demand for money is a positive function of price and real income, we can specify the savings function as follows:

$$H = H(kpy - M) \quad (8)$$

$$H(0) = 0, \text{ and } H'(kpy - M) > 0 ,$$

where

k : constant coefficient of demand for money

M : nominal quantity of domestic money.

Rewriting equation (8) in real terms, we have:

$$h = h(ky - m) \quad (9)$$

where

$$m \equiv \frac{M}{p} : \text{ real quantity of domestic money.}$$

Equation (9) indicates that an increase in real income and price leads to positive saving (hoarding) by creating an excess demand for real money, while an increase in the real stock of domestic money brings about

1. The savings function in the text is in contrast to the Keynesian type of saving function, in which real income is a major determinant of saving. For a theoretical basis of the present saving function, see L.A.Metzler, "Wealth, Saving and the Rate of Interest," Journal of Political Economy (April 1951); B. Pesek and T. Saving, "Monetary Policy, Taxes, and the Rate of Interest," Journal of Political Economy (August 1963).

dissaving (dishoarding) by creating an excess supply of real money.

Substituting equation (8) into (3), and rewriting it in real terms, we can specify the expenditure function as:

$$z_p = (y - t) - h = (y - t) - h(ky - m). \quad (10)$$

Equation (10) shows that private expenditure depends upon disposable income and real cash balances. From the equation we can see that an increase in real income reduces real private expenditure by making demand for real cash balances larger than the actual stock of them. On the other hand, an increase in the stock of money raises private expenditure by making the real quantity of domestic money larger than its desired level.

Substituting the expenditure function into the equilibrium condition of the goods market given by equation (7), and assuming that the government adopts a balanced budget policy, we can specify the equilibrium condition as:

$$b_t = h(ky - m) . \quad (11)$$

What is determined by the equilibrium condition of the goods market given by equations (7) or (11) ? Noting the particular assumptions that the home country produces only composite traded goods in full employment and that the price of home produced goods is exogenously determined by the rest of the world, we can see that the balance of trade is determined by the equilibrium condition of the goods market. For the assumption that the home country behaves as a price taker under full employment implies that it can sell all the excess of output over domestic expenditure or can purchase all the excess of domestic expenditure over output at a given world price. The balance-of-trade position of the home country, thus, depends on the private sector's expenditure and saving decisions at given levels of real income and cash balances.

To complete the present model, let us specify the balance of payments. Under the assumption that there are no international portfolio transactions, the capital account of the balance of payments is naturally equal to zero. In consequence, only the balance of trade constitutes the balance of payments, defined as the rate of change in international reserves held by the monetary authority of the home country. Thus, the external condition in terms of foreign currency is given by the following equation:

$$\frac{dR}{dt} = p^* b_t \quad , \quad (12)$$

where

R : stock of international reserves held by the
monetary authority of the home country

$\frac{dR}{dt}$: the rate of change in international reserves
held by the monetary authority.

Equation (12) indicates that disequilibrium of the balance of payments continuously affects the stock of foreign reserves held by the monetary authority of the home country. As the total quantity of base money is composed of domestic and foreign source components, this implies that under fixed rates balance-of-payments disequilibrium will continuously change the quantity of domestic money by affecting the foreign source component of base money: that is, a balance-of-payments surplus increases it, while a balance-of-payments deficit reduces it, as long as the government sector does not take any neutralization policy to prevent external disequilibrium from affecting the size of domestic money supply. The relation between the total quantity of base money and its foreign source component mentioned above is given by the following identity:

$$M \equiv R + D \quad , \quad (13)$$

where

D : domestic source component of base money (or domestic credit creation).

As will be seen later, the direct relationship between the balance of payments and the domestic money supply given by equations (12) and (13) constitutes an important channel through which the automatic monetary adjustment mechanism operates under fixed exchange rates.

(2) The Monetary Approach to the Balance of Payments

Equations (1), (8), (11), (12) and (13) represent a monetary model for a small open economy under fixed exchange rates. Several implications of the model for the balance of payments become clear when equation (11) is substituted into equation (12). This substitution gives us the following relation between the rate of change in official international reserves and the private sector's hoarding,

$$\frac{dR}{dt} = p \cdot h(ky - m). \quad (14)$$

Substituting further equation (13) into (14), we can rewrite the equation in nominal terms as :

$$\frac{dR}{dt} = H(kpy - (R+D)). \quad (15)$$

From equation (14) or (15), we can derive the following theoretical features of the monetary approach to the balance of payments.

(i) Equation (14) shows that, given equilibrium in the goods market, the balance of payments corresponds to the flow excess demand for domestic money by the private sector. In the present case, where domestic money is the only asset held by the private sector, the balance of payments directly reflects the stock adjustment process of domestic money demand. The equation indicates that the home country will have balance-of-payments

disequilibrium whenever there exists a flow excess demand for or supply of domestic money: a deficit will occur if there is an excess supply of money and a surplus if there is an excess demand for it. The balance of payments will be in equilibrium if demand for domestic money is equal to its supply.

This direct relation between the balance of payments and the flow excess demand for domestic money leads to several interesting conclusions about the short-run effects of changes in income, price, quantity of domestic money, etc.¹ First, an increase in real income will, other things being equal, bring about a balance-of-payments surplus by creating an excess demand for money.² Second, an increase in domestic price will also bring about a balance-of-payments surplus by reducing the real quantity of domestic money and thus creating an excess demand for it. Finally, an expansion of the domestic money supply will bring about the opposite effect on the balance of payments by creating an excess supply of domestic money and thereby causing the private sector to reduce its cash balances.

(ii) The adjustment process of the balance of payments is essentially a dynamic one represented by differential equation (15). A deficit (surplus) of the balance of payments will lead to a decrease (increase) in the domestic money supply by decreasing (increasing) the foreign source component of base money. The reduction (increase) in the domestic money supply will in turn make private expenditure fall (rise) by creating an

1. The short-run effect is derived under the assumption that the money supply is constant at a given level, which may not be necessarily consistent with zero balance of payments. For the definition, see R. Dornbush, op. cit.

2. This monetary view of the effect of income on the balance of payments is in contrast to the standard view based upon the Keynesian income theory, in which an increase in income is regarded as having the opposite effect on the balance of payments by increasing the level of imports. For an interesting analysis of the effect of economic growth on the balance of payments which is based upon the monetary approach to the balance of payments, see R.A. Mundell (1), op. cit. and R. Komiya, op. cit.

excess demand for (supply of) domestic money. Consequently, the reduction (increase) in expenditure will bring about an improvement (deterioration) in the balance-of-trade position of the home country, which will again affect the total quantity of domestic money by changing the stock of international reserves held by the monetary authority. Thus, if the system is stable, it will eventually reach the long-run or full equilibrium characterized by monetary equilibrium and zero-balance of payments.

The stability of the dynamic monetary adjustment process depends upon three conditions.¹ First, a balance-of-payments deficit (surplus) reduces (increases) the total quantity of domestic money by reducing (increasing) the stock of international reserves held by the monetary authority. This implies that the monetary authority does not undertake any neutralization policies to prevent external monetary disturbances from being transmitted to the domestic economy. Second, demand for money is, in the long-run, a stable function of a number of variables such as real income, price, etc., and an excess demand for (supply of) domestic money reduces (increases) the level of expenditure. The long-run stability of the money demand function is particularly important for dynamic monetary adjustment since it constitutes the basic channel through which monetary disequilibrium is transmitted to a change in expenditure. Finally, an increase (decrease) in expenditure leads to a balance-of-trade deficit (surplus).

(iii) The foregoing argument indicates that disequilibrium in the balance of payments is essentially a short-run or transitory phenomenon. Given the stability condition of the model, there exists the long-run or final equilibrium where equilibrium of the balance of payments is restored together with that of the asset market.² The impacts of economic policy

1. For the more rigorous analysis of the stability condition, see A.K. Swoboda (2), op. cit., and M. Mussa, op. cit.

2. As no real variable is included in the present model, we cannot analyze the effect of a change in a real variable on the balance of payments in short and long-run equilibrium. If neutrality of money is assumed, however, it can be proved that the real effect is also transitory and has no effect on the balance of payments in the long-run. For the

(continued)

in long-run equilibrium are often quite different from those in short-run equilibrium.¹ The distinction between the two effects becomes especially important in analysis of the effects of monetary and exchange rate policies under fixed exchange rates.

To see this, suppose that the monetary authority of the home country increases the stock of domestic credit. As already mentioned, the increase in the supply of domestic money brings about a balance-of-payments deficit in the short-run by stimulating expenditure, which leads to a decrease in foreign reserves held by the monetary authority. A decrease in foreign reserves in turn reduces the supply of domestic money and tends to have a dampening effect on expenditure, reducing the balance-of-trade deficit. That is, the automatic monetary adjustment mechanism operates until the economy reaches a new long-run equilibrium, where the desired money stock is again equal to the actual stock and payments equilibrium is restored. Given the assumption that real income remains unchanged, what happens in long-run equilibrium as a result of an expansion of quantity of domestic money is a decrease in the stock of foreign reserves held by the monetary authority by the same amount as the initial increase in domestic credit. In other words, a monetary expansion in a small open economy only leads to a change in the composition of domestic money supply as between domestic and foreign source components.²

More or less the same conclusion is obtained in the case of exchange rate policy. For example, devaluation reduces the level of real cash balances held by the private sector by increasing the domestic price level. As in the case of restrictive monetary policy, the reduction in real cash

real effect in short and long-run equilibrium, see R. Dornbush, op. cit.

1. The long-run effect is derived under the assumption that the desired money stock is equal to the actual money stock.

2. The results can be obtained if the long-run asset equilibrium condition, $kpy=R+D$, is differentiated with respect to D . Under the assumption that real income and price remain unchanged, it can be seen that a change in D brings about a change in R by the same amount.

balances in turn leads to a decrease in the private sector's expenditure and results in a balance-of-trade surplus in the short-run. Again, through the automatic monetary adjustment mechanism, a new long-run equilibrium is eventually reached where the balance of payments is equal to zero. This argument suggests that the effect of devaluation on the balance of payments is temporary and its long-run effect is nil, and that the effect of exchange rate policy works through the real cash balance effect and can be viewed as a sort of monetary policy.

(3) The Monetary Approach to Flexible Exchange Rates

In the previous section, I outlined the basic features of the monetary approach to balance-of-payments theory using a simple small-country model. If we extend the model to the case of flexible exchange rates by treating the stock of international reserves held by the monetary authority as an exogenous variable, we obtain a monetary theory of flexible exchange rates based upon the quantity theory of money.¹ Assuming that the monetary authority does not intervene in the foreign exchange market to stabilize the external value of domestic money, we can specify the external equilibrium condition as :

1. For works which emphasize the long-run aspect of flexible exchange rates, see

R. Dornbush (1), "The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy," presented to the Seminar on Flexible Exchange Rates and Stabilization Policy, Saltsjobaden, Stockholm (August 1975) (in what follows, the seminar will be referred to as Stockholm Seminar.);

R. Dornbush (2), "Exchange Rate Dynamics," Working Paper No. 167, Dept. of Economics of Massachusetts Institute of Technology (November 1975);

J. Myhrman, "Experiences of Flexible Exchange Rates in Earlier Periods: Theories, Evidence and a New View," presented to the Stockholm Seminar, Saltsjobaden, Stockholm (August 1975);

P.J.K. Kouri, "The Exchange Rate and the Balance of Payments in the Short-run and in the Long-run: A Monetary Approach," presented to the Stockholm Seminar, Saltsjobaden, Stockholm (August 1975);

M. Mussa, "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a Regime of Controlled Floating," presented to the Stockholm Seminar, Saltsjobaden, Stockholm (August 1975).

$$\frac{dR}{dt} = 0 . \quad (16)$$

As the rate of change in international reserves held by the monetary authority corresponds to the flow excess demand for domestic money by the private sector, we can specify the external equilibrium condition by the flow condition of domestic money demand and supply,

$$\frac{dR}{dt} = p^*h(ky - \frac{M}{p}) = 0 . \quad (17)$$

From equation (17), we can obtain the following alternative external equilibrium condition under flexible exchange rates,

$$ky = \frac{M}{p} . \quad (18)$$

Clearly, the equilibrium condition given by equation (18) is equivalent to the equilibrium condition of the domestic money market. It indicates that external equilibrium requires the demand and supply of domestic money to be in equilibrium. External equilibrium will not be achieved unless monetary equilibrium is attained; equilibrium of the domestic money market is indispensable for external equilibrium under flexible exchange rates.¹

An important question to be asked in this connection is how the exchange rate is determined in this model since the external condition does not explicitly include the exchange rate. To answer this question, we need to introduce an additional condition which relates the monetary equilibrium condition to the exchange rate. One way to link the monetary condition with exchange rate determination will be to assume that the exchange rate is determined by the relative purchasing power between two national currencies and to view the monetary condition as translated into the

1. The importance of equilibrium of demand and supply of domestic money is emphasized by R. Dornbush (1), op. cit. and J. Myhrman, op. cit.

exchange rate through the ratio of relative prices between two countries.¹
Then, the additional condition is given by

$$e = \frac{p}{p^*} \quad (19)$$

Combining equation (18) and (19) we obtain a monetary model of flexible exchange rates based essentially upon the quantity theory of money. We can see from the model that, given foreign price, the equilibrium exchange rate is determined along with domestic price by monetary equilibrium.

The simple monetary model of flexible exchange rates has several important properties. First, we see that the quantity of domestic money is an important determinant of the equilibrium level of the exchange rate. For example, a 10% increase (decrease) in domestic money supply brings about a 10% depreciation (appreciation) of domestic money together with a 10% increase (decrease) in the domestic price level by creating an excess supply of (demand for) domestic money. Second, the model shows that a change in real income has the opposite effect on the exchange rate and

1. The above model is basically similar to the Purchasing Power Parity Theory in the sense that the equilibrium exchange rate is linked to the relative price between domestic and foreign country. Although no explicit remark is made on the mechanism through which the exchange rate is equalized to purchasing power parity, international commodity arbitrage in a broad sense may be viewed as one possible mechanism. It should be noted that in the present model the exchange rate and domestic price are assumed to be simultaneously determined and therefore the problem of the causal relation between them, which has been one of the controversial issues in the P.P.P. theory, is regarded as being less relevant. For the interpretation of the P.P.P. theory, see G.Cassel, Money and Foreign Exchange After 1919 (London, Macmillan, 1930); G. Haberler, The Theory of International Trade (London, William Hodget and Co., 1936); L.B. Yeager, "A Rehabilitation of Purchasing-Power Parity," Journal of Political Economy, Vol. LXVI (Dec. 1958), pp.516-30; B. Balassa, The Purchasing Power Parity Doctrine: A Reappraisal, Journal of Political Economy, Vol. LXXII, No. 6 (Dec. 1964), pp.584-96.

domestic price: an increase (decrease) in real income leads to an appreciation (depreciation) of domestic money and a fall (rise) in domestic price by bringing about an excess demand for (supply of) domestic money. Finally, we note that flexible exchange rates have a strong insulation effect against international monetary disturbances. Inflation originating in a foreign country will not be transmitted to the domestic economy under flexible exchange rates because of a corresponding adjustment of the exchange rate; an increase in foreign price leads to an appreciation of domestic money by the same proportion and cannot affect domestic price.

In addition to these properties, two implications of the present model for the determination of the exchange rate should be mentioned. First, it was emphasized in the foregoing argument that the monetary condition of the demand for and supply of domestic money is a basic determinant of the exchange rate. Although the determination of the exchange rate in the present case depends partly upon purchasing power parity, the role of parity in exchange rate determination is regarded as rather secondary in that the use of the parity principle represents a theoretical proxy by which the underlying monetary conditions are translated into the determination of the exchange rate. The important implication of the emphasis on the role of monetary equilibrium as determining the exchange rate is that the exchange rate is viewed as a variable essentially determined by asset equilibrium.¹ Because of the particular assumption in the present model that domestic money is the only asset held by the private sector, asset equilibrium in the foregoing discussion was represented simply by equilibrium of domestic money. However, if the assumption is relaxed and other monetary assets, in particular foreign

1. The emphasis on the asset nature of exchange rate determination is seen in M. Mussa, *op. cit.* and J.A. Frenkel, "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," presented at the Stockholm Seminar, Saltsjobaden, Stockholm (August 1975).

monetary assets, are introduced into the model, the asset nature of exchange rate determination will become much more significant, since the proper specification of exchange rate determination must take explicitly into account the possible impact of portfolio allocation between domestic and foreign assets on the exchange rate. Thus the present simple monetary theory constitutes the first step towards the asset or portfolio approach to exchange rate determination which will be presented in the following chapters.

Second, the above model is concerned essentially with long-run determination of the exchange rate. This can be seen through the assumption made by the quantity theory of money that demand for money is a stable function of price and real income and through the assumption that other possible explanatory variables such as international assets diversification, expectations of the future exchange rate, etc., are excluded from the model. In particular, the emphasis on the long-run stability of the demand for money leads to the important implication that long-run instability in the exchange rate must be attributed to long-run instability in the supply of domestic money as long as changes in real income and relative price are relatively small.¹ The importance of the role of the quantity of money as a crucial determinant of the exchange rate will be especially noticeable when monetary authorities undertake inflationary money policies, thereby creating monetary instability. This emphasis on the long-run monetary nature of exchange rate determination constitutes a major feature of the present model which is distinguished from the standard theory.

In this chapter, I presented a monetary model of flexible exchange rates emphasizing the long-run relation between the exchange rate and the quantity of domestic money through the purchasing power parity principle. A theoretical limitation of the long-run monetary model may lie in the fact that very little attention is paid to the roles of other variables

1. This point is emphasized by J. Myhrman, op. cit.

such as interest rate differential, expectations of the future exchange rate, etc., which are considered to be important determinants of assets demand and therefore the exchange rate in the short-run. In the following chapters, I shall extend the theoretical basis of the monetary approach to the short-run case and present an alternative version of the monetary approach to flexible exchange rates concerned mainly with the short-run aspect of exchange rate determination. For this purpose, I shall discuss the importance of portfolio choice between domestic and foreign monetary assets for exchange rate determination and show its theoretical implications for the theory of flexible exchange rates.

CHAPTER III

The Portfolio Approach to Flexible Exchange Rates

In the previous chapter I presented a monetary approach to flexible exchange rates based upon the quantity theory of money. I emphasized that an important implication of the approach was that it provided a theoretical basis for viewing the exchange rate as a variable determined essentially by asset equilibrium. The aim of this chapter is to further develop the monetary view of flexible exchange rates with emphasis on the role of portfolio equilibrium between domestic and foreign monetary assets, and to present an alternative monetary approach to flexible exchange rates which will be termed the portfolio approach.¹

One of the important assumptions made in the long-run monetary approach in the previous chapter was that domestic money was the only asset held by the private sector. Consequently, the potential effect on the exchange rate of asset diversification is entirely excluded from the model. As a result, monetary disequilibrium was regarded as being transmitted to the exchange rate only through price parity between domestic and foreign countries.

The theoretical basis of the portfolio approach is that it regards demand for foreign monetary assets as constituting a nonnegligible part

1. The portfolio approach is emphasized particularly by H. Genberg and H. Kierzkowski, "Employment and Price Fluctuations under Flexible Exchange Rates," The Graduate Institute of International Studies (May 1975); P.J.K. Kouri, "The Exchange Rate and the Balance of Payments in the Short-run and in the Long-run: A Monetary Approach," presented at the Stockholm Seminar (August 1975); M. Mussa, "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a Regime of Controlled Floating", presented at the Stockholm Seminar (August 1975).

of the total demand for monetary assets by the private sector as well as demand for domestic assets. It thus looks at the determination of the exchange rate from the point of view of the private sector's asset choice between domestic and foreign monetary assets (in particular, between domestic and foreign money).¹ More precisely, the portfolio approach views the exchange rate as a variable determined by portfolio equilibrium between the two national assets. Therefore, we must begin by asking what economic reasons exist behind the private sector's demand for foreign monetary assets.

We can point out two economic reasons for the private sector's demand for foreign monetary assets.

The first reason is the need for liquidity for transactions purposes. This arises from two related factors: the lack of perfect synchronization between international payments and receipts and the existence of transactions costs associated with the exchange of domestic monetary assets for foreign monetary assets. Clearly, in the case of international transactions just as in the case of domestic transactions, it is quite unlikely that the flows of payments by economic units of one country are always accompanied by the same amount of flows of receipts to them; payments may exceed receipts or the latter may exceed the former. This lack of perfect synchronization between international payments and receipts naturally causes the private sector to hold an inventory of liquid assets to meet occasional imbalances. Of course, liquid assets which are needed for international payments could be held entirely in domestic monetary assets and exchanged for foreign monetary assets when the need arises. However, a tendency will emerge for the private sector to hold a part of its required inventory of liquidity for international transactions in foreign monetary assets whenever the exchange of domestic liquid assets for foreign is accompanied by transactions costs such as "broker's fee, bank

1. Monetary assets are defined as those assets that are marketable, fixed in money value and free of default risk. For this definition, see J.Tobin, "Liquidity Preference as Behaviour Toward Risk," Review of Economic Studies, Vol. 25, No. 67 (February 1958), pp. 65-86.

charges, bookkeeping costs, psychological inconvenience, etc".¹ Thus, transactions costs and the lack of perfect synchronization in international payments combine to induce the private sector to demand an inventory of foreign monetary assets for transactions purposes.

The second reason, which is quite familiar, is based upon the private sector's desire to seek the most profitable use of its wealth, namely, its investment motive to obtain the highest rate of yield from a given amount of funds. Clearly, this investment motive will induce the private sector to expand the range of its portfolio choice to include foreign monetary assets, provided that there are no serious obstacles to international assets transactions and that foreign monetary assets are attractive financial instruments in terms of rate of return and risk. In that case, the private sector will naturally diversify its wealth as between domestic and foreign assets, depending upon the expected relative rates of return and risks between the two national assets. Thus, the investment motive will constitute another economic reason why foreign monetary assets are demanded by the private sector of a country.

Obviously, the aggregate size and economic determinants of the demand for foreign monetary assets will depend upon the transactions and investment demands for them. The volume of international transactions denominated in foreign currency will be the major economic determinant of the transactions demand, given transactions costs and the institutional arrangements which determine the degree of synchronization between international payments and receipts. In general, the transactions demand will vary roughly in proportion to the value of foreign transactions: the larger the value of foreign transactions, the greater will be the transactions demand for foreign assets.

1. It is implicitly supposed that domestic currency has only a limited acceptability as a medium of exchange in international trade. The importance of the role of transactions costs for the private sector's demand for foreign liquid assets is pointed out by A.K. Swoboda, "The Eurodollar Market: An Interpretation," Essays in International Finance, Princeton University, No. 64 (February 1968).

On the other hand, the yield differential between domestic and foreign assets will be the most important determinant of the investment demand, together with the risk differential between them. Under flexible exchange rates, yield differential is divided roughly into two components: interest rate differential and the expected rate of change in the exchange rate. Noting that the latter can be further divided into the present and the expected future exchange rates, we can alternatively say that, given risk factors, the investment demand for foreign monetary assets depends to a large extent upon the interest rate differential and the present and expected exchange rates. The investment demand will be larger, the higher the foreign rate of interest and the greater the probability that domestic money will depreciate in the future.

So far we have been concerned with the economic reasons behind, and determinants of, demand for foreign monetary assets by the private sector. Needless to say, the existing stock of foreign monetary assets will not necessarily be equal to the demand for them; demand may often be larger than existing stock or the other way around. This poses the important question of how the private sector reconciles disequilibria.

There are several ways in which actual holdings of foreign monetary assets may be adjusted to desired holdings when a divergence arises between them. For example, the private sector may be able to increase its holdings of foreign monetary assets through borrowings from the foreign private sector when an excess demand for foreign monetary assets arises; it may reduce its actual holdings of foreign monetary assets by purchasing foreign capital assets when the existing stock of foreign monetary assets is larger than the demand for them. But, the most important way in which the private sector operates is through exchanging one national monetary asset for another. If its demand for foreign monetary assets is larger than actual holdings, the private sector will release part of its domestic assets in order to eliminate the excess demand for foreign monetary assets; conversely, if its demand for foreign monetary assets is smaller than actual holdings, the private sector will purchase domestic monetary assets to

eliminate the excess holdings of foreign monetary assets. Obviously, this portfolio adjustment will continue until the demand for foreign monetary assets becomes equal to the existing level of them, or until the actual stock of foreign monetary assets is willingly held by the private sector. Noting that an excess demand for (supply of) foreign monetary assets reflects at the same time an excess supply of (demand for) domestic monetary assets, we could alternatively say that monetary adjustment will continue until portfolio equilibrium between domestic and foreign monetary assets is attained so that the existing stocks of the two national assets are held willingly.

The preceding discussion of the portfolio adjustment between domestic and foreign monetary assets leads us to a crucial question that is closely related to the portfolio view of exchange rate determination in this paper: how is portfolio disequilibrium between domestic and foreign monetary assets reconciled so that existing stocks are held willingly? The answer given by this paper is that portfolio disequilibrium is reconciled through adjustment of the exchange rate: that is, a disequilibrium between domestic and foreign monetary assets which would be resolved through a change in official international reserves under fixed exchange rates, induces a variation of the exchange rate under flexible exchange rates. This in turn has a repercussion on demands for the two national assets by changing the expected rate of exchange-rate and therefore yield differential between them.

To illustrate this view in more detail, we suppose that an excess demand for foreign monetary assets arises. This excess demand, which would lead to a decrease in the stock of international reserves held by monetary authorities under fixed exchange rates, will cause a depreciation of domestic money under flexible exchange rates by inducing an excess supply of domestic monetary assets. A depreciation of domestic money will in turn tend to lower the expected rate of return on foreign monetary assets by making the expected rate of appreciation of foreign money smaller (given the expectation of the future exchange rate) and as a result weaken

the initial excess demand for foreign monetary assets.¹ Thus, the exchange rate will continue to adjust until depreciation of domestic money makes the expected rate of appreciation of foreign money (given the interest rate differential, expectation of the future rate, and other exogenous variables such as the stocks of domestic and foreign monetary assets) small enough to induce the private sector to willingly hold the existing stocks of domestic and foreign monetary assets.²

1. Obviously, the expected future exchange rate will not be independent of the current exchange rate and the stability of exchange rate determination will be significantly affected by the type of expectation which the private sector forms. The present assumption is made solely for the convenience of explanation.

2. The interest-rate nature of the expected rate of exchange rate change and its importance for the determination of the current exchange rate are also pointed out by the standard theory in relation to speculators' behaviour in the foreign exchange market. For example, see M. Friedman, "The Case for Flexible Exchange Rates," in M. Friedman, Essays in Positive Economics, (Chicago, University of Chicago Press, 1953), pp. 157-203; S.C. Tsiang, "The Theory of Forward Exchange and Effects of Government Intervention in the Forward Exchange Market," International Monetary Fund Staff Papers, Vol. 7 (April 1959), pp. 75-106;

M. Friedman argues that "if the exchange rate depreciates, for example, the tendency for the exchange rate to fall further initially than ultimately, offers an opportunity to make a profit by buying the currency now and selling it later at a higher price. But this is precisely equivalent to lending by speculators to the country whose currency they hold appreciates. The return to the speculators is equal to the rate at which the currency they hold appreciates.---- Moreover, the prospect of appreciation of a currency is equivalent to a higher interest rate for loans to the country and thus serves the same function in attracting capital to that country as the rise in interest rate that took place under the gold standard when a country was losing gold." (See M. Friedman, op. cit.)

One of the features of the present portfolio approach may be said to lie in extending "speculators' behavior", traditionally confined to a narrow theoretical framework of the foreign exchange market represented by the supply and demand of foreign exchange, to a broader theoretical framework of macro-economic portfolio choice between domestic and foreign monetary assets and thus bringing out the importance of the stocks of the two national assets for exchange rate determination, which was not necessarily fully recognized by the standard theory.

The current view of the relation between the exchange rate and portfolio adjustment is based crucially upon the role of the exchange rate in determining assets diversification. The exchange rate constitutes one of the economic determinants of the portfolio composition between domestic and foreign monetary assets under flexible exchange rates through its effect on the expected rate of exchange rate change. It was noted that investment demands for domestic and foreign monetary assets depend partly upon the expected rate of exchange rate change as well as other variables such as the interest rate differential, risks, the stock of wealth, etc. Thus, a change in the exchange rate was regarded as bringing about a change in investment demands for the two national assets by altering the expected rate of future exchange rate change. That is, a depreciation of domestic money reduces demand for foreign monetary assets by making the expected capital gains from holdings of foreign monetary assets smaller under a given expectation of the future exchange rate; conversely, an appreciation of domestic money brings about the opposite result by making the expected capital gains from holdings of foreign monetary assets larger under a given expectation of the future exchange rate. It is this relation between the exchange rate and investment demands for domestic and foreign monetary assets that leads to the portfolio view of exchange rate determination, which states that the equilibrium exchange rate is determined by portfolio equilibrium between the two national assets at the level where the expected rate of appreciation or depreciation of domestic money (given exogenous variables, such as the expectation on the future rate, the domestic and foreign interest rates, risks, etc.) is large enough to induce the private sector to willingly hold the existing stocks of the two national assets.¹

1. H. Genberg and H. Kierzkowski, op. cit. and P.J.K. Kouri, op. cit. take a different view on the role of the exchange rate in portfolio equilibrium between the two national assets. They argue that the exchange rate has a repercussion on portfolio equilibrium mainly by changing its supply condition.

Two features of the portfolio approach to exchange rate determination are worth noting.

(i) The view that the exchange rate is determined by portfolio equilibrium between domestic and foreign monetary assets obviously means that determination of the exchange rate depends upon all those variables that constitute such equilibrium: the exchange rate will fluctuate whenever exogenous changes in those variables induce a portfolio disequilibrium between the two national assets. Although the exact specification of these variables requires a theoretical derivation of the demand functions for domestic and foreign monetary assets, we can infer from the preceding discussion that the stocks of the two national assets and the expectation on the future rate are particularly important variables in the determination of the equilibrium exchange rate.¹

A change in the stocks of the two national assets (in particular, domestic and foreign money) will have a strong impact on the equilibrium exchange rate by directly changing the supply condition of portfolio equilibrium. For example, an increase (decrease) in domestic monetary assets held by the private sector will make domestic money depreciation (appreciate) by creating an excess demand for foreign (domestic) monetary assets; on the other hand, an increase (decrease) in foreign monetary assets held by the private sector will make domestic money appreciate (depreciate) by leading to an excess demand for domestic (foreign) monetary assets. This argument concerning the role of monetary assets in exchange rate determination suggests that, in the portfolio approach as in the simple monetary approach based upon the quantity theory of money, domestic money is still an important determinant of the equilibrium exchange rate, and domestic monetary policy will be a key variable for the stability of the external value of domestic money. The portfolio approach implies, however, that the impact of a change in domestic money supply on the exchange rate will be felt not through price parity between domestic and

1. The demand functions for domestic and foreign monetary assets are derived in the next chapter.

foreign countries but through portfolio readjustment on the part of the private sector.

Expectations of the exchange rate in future periods will also have a strong impact on the current rate by directly affecting the expected rate of exchange-rate change and thereby changing demands for domestic and foreign monetary assets. The expectation that domestic money will depreciate in the future will lead to a depreciation of domestic money in the current period by raising the expected rate of return on foreign monetary assets and thereby creating an excess demand for them; conversely, the expectation that foreign money will depreciate in the future will bring about the opposite effect on the external value of domestic money in the current period by raising the expected rate of return on domestic monetary assets and thereby creating an excess demand for them. Thus, it follows that stability of the exchange rate depends significantly upon stability of expectations on the future exchange rate. It is quite likely that sporadic fluctuations in the exchange rate will be observed, in particular in the short-run whenever expectations on the future rate are affected by sudden changes in exogenous variables.¹

(ii) Unlike the standard approach which regards the exchange rate as being determined by flow equilibrium between the demand and supply of foreign exchange, the portfolio approach views the exchange rate as determined by stock equilibrium as far as the demand and supply of assets are specified as stocks rather than flows. Under this view we may ask what is determined by the balance of payments, which constitutes the equilibrium condition for exchange rate determination in the standard theory of flexible

1. This argument suggests the importance of incorporating the theory of expectations in the theory of flexible exchange rates. For an interesting attempt to incorporate the rational expectation hypothesis with the macro model of flexible exchange rates, see R. Dornbush, "Exchange Rate Dynamics", Working paper, No. 167, Dept. of Economics of Massachusetts Institute of Technology (November 1975); M. Mussa, "Real and Monetary Factors in a Dynamic Theory of Foreign Exchange," International Monetary Research Programme, London School of Economics and Political Science (June 1976).

exchange rates. The answer given by the portfolio approach to this question is to view the balance of payments as determining the rate of change in the stock of foreign monetary assets held by the private sector.¹ This implies that disequilibria of the balance of payments of a country affect the exchange rate indirectly by continuously changing the supply condition of the portfolio equilibrium between domestic and foreign monetary assets; that is, a surplus (deficit) of the balance of payments makes domestic money appreciate (depreciate) by inducing an excess supply of (demand for) foreign monetary assets.

The view that the balance of payments determines the rate of change in the stock of foreign monetary assets held by the private sector under flexible exchange rates presupposes the assumption mentioned in the preceding paragraphs that the private sector holds an inventory of foreign monetary assets to meet occasional discrepancies between international payments and receipts. This implies that, when faced with such discrepancies, the private sector will try to reconcile them by using its foreign monetary assets as a buffer stock or a shock absorber. That is, if receipts exceed payments, the private sector will increase its holdings of foreign monetary assets temporarily. Conversely, if payments exceed receipts, it will reduce its holdings of foreign monetary assets. Occasional discrepancies between international payments and receipts, which would be reconciled under fixed exchange rates through changes in the foreign reserves held by the monetary authorities, will be reconciled under flexible exchange rates through corresponding changes in the stock of foreign assets held by the private sector. Such changes in turn induce variations of the exchange rate through portfolio adjustment between domestic and foreign monetary assets.

Thus the portfolio approach to flexible exchange rates is characterized by a dynamic property quite similar to the one discussed with the help of the simple macro model of fixed exchange rates in chapter 2. A disequili-

1. Strictly speaking, it is the balance of trade or the current account that determines the rate of change in the stock of foreign monetary assets held by the private sector. For this point, see the simple model presented later in this chapter.

brium of the balance of payments under flexible exchange rates leads to a change in the stock of foreign monetary assets held by the private sector, which in turn affects the exchange rate by inducing a portfolio adjustment between domestic and foreign monetary assets. A variation in the exchange rate will have a repercussion on the balance of payments as long as it affects income and absorption through various channels. In the stationary model where no growth of capital and labour is assumed, dynamic monetary adjustment involving changes in the exchange rate instead of changes in official international reserves will continue until equilibrium of the balance of payments is attained.¹

This portfolio view of flexible exchange rates can be illustrated through the use of a macro model. To facilitate the illustration, we consider the simple macro model presented in chapter 2 for discussion of the monetary approach to the balance of payments. To make the model applicable to the case of flexible exchange rates we introduce the following three assumptions in addition to those that were already made in chapter 2: (i) the private sector of the home country demands not only domestic but also foreign money; (ii) the exchange rate is determined by portfolio equilibrium between domestic and foreign money; (iii) the government sector does not intervene in the foreign exchange market at all to stabilize the external value of domestic money at a certain level, and the foreign source component of the monetary base of the home country is treated as an exogenous variable.

Using these assumptions we can specify several key equations essential for the portfolio approach to flexible exchange rates.

First, suppose that exchange rate determination is represented by the following reduced form equation which reflects portfolio equilibrium between domestic and foreign money:²

1. For the dynamic monetary adjustment under flexible exchange rates, see H. Genberg and H. Kierzkowski, op. cit.; P.J.K. Kouri, op. cit.

2. The specification of equation (1) is not perfect in the sense that it
(continued)

$$e = e(M, M^*, \hat{e}, \dots) , \quad (1)$$

where

- e : exchange rate: price of foreign money in terms of domestic money
- $\hat{e}$: expected future exchange rate
- M : stock of domestic money held by the private sector
- M^* : stock of foreign money held by the private sector .

The above equation shows that the exchange rate depends upon a number of variables such as the expected future exchange rate, the stocks of domestic and foreign money, etc. The partial derivatives $\frac{de}{dM}$, $\frac{de}{dM^*}$ and $\frac{de}{d\hat{e}}$ are positive, negative and positive, respectively.

The price equation is given by equation (2) below in the case where the home country is assumed to be a small country and to produce only traded goods:

$$p = ep^* , \quad (2)$$

where

- p : price in the home country
- p^* : foreign price of traded goods.

From equations (1) and (2) we see that the exchange rate and the domestic price level are determined simultaneously in this model, given the stocks of domestic and foreign money, foreign price, the expectation on the future exchange rate, etc.

does not cover other variables, such as domestic and foreign prices, risks, etc., that are also considered to affect the exchange rate under the portfolio approach. The specification is presented only for explanatory convenience in this chapter. The derivation of a more rigorous reduced form equation for exchange rate determination is discussed in the next chapter.

In addition to these two equations, we specify two dynamic equations which represent changes in the stocks of domestic and foreign money over time. To do so, we need to link the flow conditions such as saving, the balance of trade and the government expenditure to the dynamic stock adjustment equations. Let us first specify the savings function. Given the assumption that the private sector demands not only domestic but also foreign money, the savings function specified in chapter 2 will be modified as :

$$h = h(\hat{w} - \frac{1}{p}(M+eM^*)) \quad , \quad (3)$$

where

h : real saving

$\hat{w}$: desired wealth stock which is assumed being
a function of real income.

The savings function determines the size of wealth accumulation by the private sector at any point in time. Under the assumption that assets are composed of domestic and foreign money, savings will be made in both monies. The composition of savings will, however, depend significantly upon the fiscal policy of the government and the balance-of-trade position of the home country. Given the assumption that the government sector does not intervene in the foreign exchange market, the rate of change in domestic money supply is entirely determined by the difference between government expenditure and tax revenues. On the other hand, the rate of change in the stock of foreign money held by the private sector is determined by the balance-of-trade position of the home country. Thus, the dynamic stock adjustment equations for domestic and foreign money are specified as follows:¹

1. For the dynamic portfolio model, see J. Tobin "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit and Banking, Vol. 1, No. 1 (February 1969); W.H. Branson, "Macroeconomic Equilibrium with Portfolio Balance in Open Economies," Seminar Paper No. 22, Institute for International Economic Studies (November 1972); R.I. McKinnon, "Portfolio Balance and International Payments Adjustment" in R.A. Mundell and A.K.

(Continued)

$$\frac{dM}{dt} = p(z_g - t) \quad (4)$$

$$\frac{dM^*}{dt} = p^*b_t, \quad (5)$$

where

z_g : real government expenditure

t : real tax revenue

b_t : the balance of trade.

Equation (4) states that an excess of government expenditure over tax revenues increases the stock of domestic money over time, while equation (5) shows that a balance of trade surplus increases the stock of foreign money held by the private sector. The sum of changes in domestic and foreign money determined by the two equations at any point in time will always satisfy the flow constraint given by ex ante savings as long as the commodity flow equilibrium is maintained. That is, the flow equilibrium condition of traded goods

$$y = z_p + z_g + b_t, \quad (6)$$

where

y : real output of the home country

z_p : private expenditure,

will be transformed to the following equation if the budget constraints of the private and government sectors are substituted into equation (6)¹:

Swoboda (eds), Monetary Problems of the International Economy (Chicago: University of Chicago Press, 1969); R.W. Jones, "Comment: 'Portfolio Balance and International Payments Adjustment'," in R.A. Mundell and A.K. Swoboda, ibid.

1. The budget constraints of the private and the government sectors are given by

$$y - t \equiv z_p + h \quad \text{and} \quad \frac{1}{p} \left(\frac{dM}{dt} \right) \equiv z_g - t$$

Note that, in chapter 2, $\frac{dM}{dt}$ was assumed to be zero when the budget constraint of the government sector was specified.

$$h = (z_g - t) + b_t \quad (7)$$

Equation (7) indicates that the sum of the excess of government expenditure over tax revenue and the balance of trade is equal to savings and therefore satisfies the flow wealth constraint.

Next we assume that the government sector adopts a balanced budget policy, namely, $z_g = t$. Obviously, under this assumption, the rate of change in the stock of domestic money will be equal to zero. Consequently, wealth accumulation by the private sector will be made entirely in foreign money and the dynamic stock adjustment will be given by equation (5). Substituting condition (7) into (5) under the assumption $(z_g - t) = 0$ and noting the savings function given by (3), we can respecify the dynamic stock adjustment equation of foreign money held by the private sector as :

$$\frac{dM^*}{dt} = p^*b_t = p^*h(\bar{w} - \frac{1}{p}(M + eM^*)) \quad (8)$$

From equation (8) we see that the balance-of-trade position of the home country and the accumulation of foreign money depend entirely upon the savings decision made by the private sector. Obviously, positive savings will bring about a surplus of the balance of trade and an increase in the stock of foreign money held by the private sector; conversely, negative savings will produce the opposite effects on the balance of trade and the stock of foreign money.

Equations (1), (2), (6) and (8) outlined a simple macro model of flexible exchange rates. The equilibrium exchange rate is determined by the stock equilibrium condition of equation (1) reflecting portfolio equilibrium between domestic and foreign money. Domestic price is determined by equation (2) along with the exchange rate. The exchange rate and domestic price thus determined will move one equilibrium point to another as the stock of foreign money held by the private sector changes over time through non-zero balance of trade. At the same time, changes in the exchange rate and domestic price induced by a change in the foreign money

stock will in turn have a repercussion on the volume of savings and the balance of trade through the wealth effect. Thus, if stability of the model is assumed, the system will reach the long-run stationary state where the balance of trade is in equilibrium and savings are equal to zero. This dynamic monetary adjustment is quite similar to the one under fixed exchange rates discussed in the previous chapter except that it is the stock of foreign money held by the private sector, not the stock of domestic money that induces the dynamic monetary adjustment in this case.¹

Given the portfolio approach to exchange rate determination discussed in this chapter, it is important to further develop the approach in the following three directions. First, we must derive the demand functions for domestic and foreign monetary assets and specify the portfolio equilibrium condition associated with them more precisely. This will provide us with a theoretical underpinning for the choice of those variables which will play the major role in the determination of the exchange rate. Second, we must incorporate the portfolio equilibrium condition for exchange rate determination thus specified into a more general macro model than the one presented in this chapter and analyze theoretical problems such as the effects of macroeconomic policy and real and monetary foreign disturbances on the exchange rate, domestic price, interest rate, etc. Finally, we must ask to what extent the portfolio approach to exchange rate determination is supported by empirical evidence. To answer this question, some empirical tests on the portfolio approach will be necessary.

In the next chapter I derive the demand functions for domestic and foreign monetary assets and specify a reduced form equation for exchange rate determination under the portfolio approach.

1. This type of monetary adjustment is emphasized by P.J.K. Kouri, op.cit.

CHAPTER IV

Portfolio Equilibrium and the Exchange Rate

In chapter 3, it was suggested that exchange rate determination can be formulated in terms of portfolio or asset equilibrium between domestic and foreign assets. It was argued that the equilibrium exchange rate is obtained when the existing stocks of domestic and foreign assets are willingly held; the exchange rate fluctuates whenever the private sector changes its allocation of liquid wealth between the two national assets. The purpose of this chapter is to discuss the portfolio approach to the exchange rate in more detail by presenting a theoretical specification of the asset equilibrium condition which determines the exchange rate. In doing so, I focus the discussion on the economic determinants of the demand functions for domestic and foreign assets (namely, the economic determinants of portfolio diversification), since the supply condition is simply given by the existing stocks of the two national assets.

(1) General Assumptions

Several remarks on the general assumptions under which the demand functions for domestic and foreign assets are derived will be necessary.

(a) It is assumed that each of the national assets is composed of only those assets that are marketable, fixed in money value and free of default risk. That is, what the following discussion is concerned with is the specification of the demand functions for monetary or liquid assets which consist mainly of money and (short-term) interest-bearing assets. This assumption is justified on the grounds that demand for non-monetary assets such as corporate stocks, real estate, etc. are generally much less sensitive to expected changes in the exchange rate as compared with demand for monetary assets and can therefore be regarded as playing a less important role in the determination of the exchange rate.

(b) It should be noted that the following discussion is concerned strictly with portfolio choice between domestic and foreign assets and not with that between money and interest-bearing monetary assets in each of the national assets. This means that the portfolio choice between money and interest-bearing assets in each national asset is regarded as concerned essentially with the determination of the rate of interest and therefore can be treated as an analytically different problem from that of the determination of the exchange rate.¹ To focus the discussion on the determination of the exchange rate, each of the national assets will be treated as composite assets, the interest rate of which is assumed to be exogenously given. However, this does not mean that the two types of portfolio choice are independent of each other and do not take place simultaneously. The present assumption is used for explanatory convenience in order to emphasize the relationship between the exchange rate and the portfolio choice between domestic and foreign assets.

(c) In deriving the demand functions for domestic and foreign liquid assets, two different economic reasons for holding assets will be distinguished: transactions reasons and investment reasons. As stated before, transactions demand stems from the lack of perfect synchronization between the flows of receipts and payments giving rise to seasonal excesses of payments over receipts. The transactions demand for each national asset will be assumed to depend primarily upon the aggregate value of transactions denominated in its currency, given institutional arrangements which determine the degree of synchronization between receipts and payments. On the other hand, investment demand for assets stems from the desire of various economic units (banks, financial institutions, firms, etc.) to seek the most profitable uses of their wealth. It is assumed that each

1. For the theoretical assumption that the determination of the interest rate is connected with the portfolio choice between money and interest-bearing assets, see J. Tobin, "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies, Vol. 25, No. 67 (February 1958), pp. 65-86.

economic unit determines its composition of investment demand so as to maximize the sum of rates of return from domestic and foreign assets under given interest rates and expectations of the future exchange rate.

(d) As one way of incorporating the effect of expectations on investment demand for domestic and foreign monetary assets, it is assumed that economic units are uncertain about the future exchange rate. More precisely, the future exchange rate is treated as a random variable and economic units are assumed to base their portfolio decisions on their estimates of probability of the future rate. Using this assumption, I apply the "mean-variance" approach to portfolio choice developed by J. Tobin and H. Markowitz to derive the investment demand functions for the two national assets.¹

In what follows I first discuss the representative individual's optimal assets diversification decision and later aggregate it to obtain aggregate demand for domestic and foreign assets.

(2) Portfolio Choice and the Exchange Rate

Suppose an individual (the j -th individual) initially holds his entire wealth in domestic monetary assets before proceeding to diversify it between holdings of domestic and foreign assets. Suppose also that he engages only in domestic transactions; that is, all his transactions are denominated in domestic currency. As already noted, in order to meet possible seasonal discrepancies between payments and receipts, he will need to hold a certain amount of domestic liquid assets for those transactions which may be termed transactions balances.² Taking into account the assumption that the need for transactions balances vary roughly in proportion to the value of transactions and that the value of transactions in

1. The discussion in what follows is based upon J. Tobin, *op. cit.* and H. Markowitz, *Portfolio Selection: Efficient Diversification of Investments*, (New York: Wiley, 1959).

2. Transactions balances are defined as composed of not only money but also short-term interest-bearing assets.

turn can be divided into price and real volume of transactions, we can specify the j -th individual's transactions demand for domestic assets as follows:¹

$$T_j = kpy_j, \quad (1)$$

where

T_j : transactions demand for domestic assets by the j -th individual

p : price

y_j : real volume of domestic transactions of the j -th individual

k : constant coefficient .

Defining investment balances as the difference between the individual's monetary wealth and his transactions balances, we can denote the j -th individual's investment balances by:

$$I_j = A_j - T_j = A_j - kpy_j, \quad (2)$$

1. It should be noted that although it is assumed in the specification of equation (1) that the transaction demand for monetary assets does not depend upon the expected rate of exchange rate change, this may not necessarily be the case. For example, if economic units expect that domestic money will depreciate in future periods, they will hold part of transactions balances in foreign monetary assets and exchange part of them for domestic monetary assets when the need for them arises. Thus, strictly speaking, the size of transactions balances will be regarded as a function of not only the volume of transactions (and transactions costs as mentioned in the previous chapter) but also the expected future exchange rate. However, the present discussion neglects the effect of the expected future exchange rate on the transactions demand in order to avoid complexities. Instead, all asset diversifications associated with the expected future exchange rate are regarded as part of investment demand which is discussed in what follows.

where

I_j : investment balances of the j -th individual

A_j : the j -th individual's monetary wealth denominated in domestic currency.

In general, the j -th individual will hold his investment balances in domestic and foreign assets according to the rate of return he can obtain on them. Under a system of flexible exchange rates, yield differentials between the two national assets are composed of interest rate differentials and the expected rate of depreciation (or appreciation); the latter can be divided further into the expected future exchange rate and the current exchange rate. Consequently, the composition of investment balances depends upon the expected exchange rate, given the domestic and foreign rates of interest and the current exchange rate. In order to specify the possible impact of the expectation of the future exchange rate on the composition of investment balances in the framework of portfolio theory, we make the following assumptions.

(i) the j -th individual is uncertain about the future exchange rate and bases his portfolio decision on his estimate of the probability distribution of the future exchange rate ($\hat{e}$);

(ii) the probability distribution of the future exchange rate has an expected value of $E(\hat{e})$ and a standard deviation of $V(\hat{e})$;

(iii) the j -th individual is a risk-averter and has a utility function given by the following quadratic function

$$U(z) = -c_1 z^2 + c_2 z, \quad (3)$$

where c_1 is assumed to be positive because of the assumption that the j -th individual is a risk averter;¹

1. The utility function cannot be defined for the whole range of z , since marginal utility will be negative if z is larger than $c_2/2c_1$. The effective range of z for a risk averter is

$$z \leq c_2/2c_1.$$

(iv) the j -th individual's liquid wealth is allocated so as to maximize the expected value of utility, given an opportunity locus defined as the terms on which he can obtain greater expected return at the expense of assuming more risk.

We first specify the opportunity locus in order to derive the condition for the optimum asset composition for the j -th individual. Assuming that the average rates of interest on domestic and foreign assets are given by i and i^* , respectively, return on a portfolio z arising from a unit of investment made by the j -th individual is represented by

$$z = n_1 i + n_2 (i^* + x) \quad \text{and} \quad (4)$$

$$n_1 + n_2 = 1, \quad (5)$$

where

n_1, n_2 : ratios of investment demand for domestic and foreign assets to I_j respectively

$$n_1 \equiv \hat{I}_j / I_j \quad n_2 \equiv \hat{I}_j^* / I_j$$

$\hat{I}_j$: the j -th individual's investment demand for domestic assets in domestic currency units

$\hat{I}_j^*$: the j -th individual's investment demand for foreign assets in domestic currency units

x : the expected rate of depreciation (if $x > 0$) or appreciation (if $x < 0$) of domestic currency

$$x \equiv s(\hat{e} - e)$$

s : constant coefficient which represents the elasticity of x with respect to $(\hat{e} - e)$

e : the current exchange rate defined as the price of a unit of foreign currency in terms of domestic currency units

$\hat{e}$: the expected future exchange rate, treated as a random variable.

Then, the expected return on the portfolio and risk on the portfolio measured by the standard deviation of z are given by

$$E(z) = n_1 i + n_2 (i^* + E(x)) \quad \text{and} \quad (6)$$

$$V(z) = n_2 V(x) \quad , \quad (7)$$

where

$E(z)$: expected return on portfolio z

$V(z)$: risk of portfolio z ,

$E(x)$: expected value of the expected rate of exchange rate change x

$$E(x) = s(E(\hat{e}) - e)$$

$E(\hat{e})$: the expected value of the future exchange rate

$V(x)$: standard deviation of the expected rate of exchange rate change x

$$V(x) = s^2 V(\hat{e}) \quad .$$

Substituting $n_1 = 1 - n_2$ into equation (6) and eliminating n_2 from equations (6) and (7), we can specify the opportunity locus by

$$E(z) = i + \frac{(i^* + E(x) - i)}{V(x)} V(z) \quad . \quad (8)$$

Equation (8) shows that the slope of the opportunity locus depends upon yield differential and the standard deviation of x ; an increase in the foreign interest rate and the expected rate of depreciation makes the slope of the opportunity locus steeper, while an increase in the domestic interest rate makes the slope flatter. An increase in the standard deviation of x will make the slope flatter.

Next, we introduce the j -th individual's preferences as between expected return $E(z)$ and risk $V(z)$. Given the utility function defined by equation (3), the expected value of utility will be defined as

$$E(U(z)) = c_2 E(z) - c_1 (E(z))^2 + V(z)^2 \quad (9)$$

Equation (9) shows that there are combinations of $E(z)$ and $V(z)$ corresponding to a given level of the expected value of utility. The locus of combinations of $E(z)$ and $V(z)$, which is defined as indifference curve, represents the j -th individual's preference between expected return and risk; he is indifferent as between all combinations of $E(z)$ and $V(z)$ which lie on the same locus. Under the assumption that the j -th individual is a risk-avertter (namely, he will not be satisfied to accept more risk unless he can expect greater expected return), the indifference curve is positively sloped.¹ Differentiating equation (9) at a given level of the expected value of utility, we can show that the slope of the indifference curve is given by

$$\frac{dE(z)}{dV(z)} = \frac{V(z)}{g - E(z)} \quad (10)$$

where

$$g \equiv \frac{c_2}{2c_1}.$$

Thus, the opportunity locus shown by equation (8) and the slope of indifference curves shown by equation (10) represent conditions under which the j -th individual achieves the highest level of the expected value of utility. Obviously, he can maximize his expected value of utility when the opportunity locus is tangent to one of the indifference curves. From equations (8) and (10), the maximizing condition is

$$\frac{V(z)}{g - E(z)} = \frac{i^* + E(x) - i}{V(x)} \quad (11)$$

Thus we have four conditions (equations (5), (6), (7) and (11)) from which we can obtain the equilibrium values of n_1 , n_2 , $E(z)$ and $V(z)$, given

1. For this point see J. Tobin, op. cit.

exogenous variables i , i^* , $E(x)$ and $V(x)$. Solving these equations we obtain

$$n_2 = \frac{h(g - i)}{V(x)^2 + h^2}, \quad (12) \quad \text{where, } h \equiv i^* + E(x) - i.$$

The equilibrium value of n_2 indicates that the j -th individual diversifies his assets holdings only when the opportunity locus has a positive slope (that is, $h \equiv i^* + E(x) - i > 0$). If the slope of the opportunity locus is negative, maximization of the expected value of utility will occur at a corner. Then the corresponding equilibrium values of $E(z)$ and $V(z)$ are

$$E(z) = i \quad \text{and}$$

$$V(z) = 0.$$

In this case, the j -th individual will have his entire wealth in domestic assets and will not hold any foreign assets at all.

On the other hand, if we assume that the slope of the opportunity locus is positive, the optimal ratio of domestic assets to investment balances (namely, n_1) is determined by:

$$n_1 = 1 - \frac{h(g - i)}{V(x)^2 + h^2}. \quad (13)$$

Equations (12) and (13) indicate that the optimal ratios of domestic and foreign assets to investment balances depend upon the yield differential between domestic and foreign assets, the standard deviation of the expected rate of depreciation, etc. Differentiating these equations with respect to the above-mentioned parameters, we can derive the following conclusions.

(a) As long as the standard deviation of the expected rate of depreciation (or appreciation) (namely, $V(x)$) is larger than the yield differential (h), an increase (decrease) in yield on foreign assets ($i^* + E(x)$) relative to that on domestic assets stimulates (reduces) the demand for foreign assets and decreases (increases) the demand for

domestic assets.¹ Noting that $E(x)$ is equal to $s(E(\tilde{e}) - e)$, we can obtain the following effects of a change in the current and expected future exchange rates on demand for domestic and foreign assets: a depreciation (appreciation) of domestic currency will reduce (stimulate) demand for foreign assets and raise (reduce) demand for domestic assets by making the expected rate of depreciation of domestic currency smaller (larger), as long as the expected future exchange rate ($E(\tilde{e})$) is independent of the current exchange rate and remains unchanged.² On the other hand, the expectation that domestic (foreign) currency will depreciate in future periods leads to an increase in demand for foreign (domestic) assets by making the expected rate of return on foreign assets larger (smaller).

(b) An increase in the standard deviation of the expected rate of depreciation (of domestic currency) will reduce demand for foreign assets and increase demand for domestic assets by increasing the risk of holding foreign assets. A decrease in the standard deviation of the expected rate of depreciation (of domestic currency) will bring about the opposite effect on demands for domestic and foreign assets by decreasing the risk of holding foreign assets.³

1. Differentiating equation (12) with respect to h , we obtain the following derivative,

$$\frac{dn_2}{dh} = \frac{(g - i)(V(x)^2 - h^2)}{(V(x)^2 + h^2)^2}.$$

Noting that g is larger than i under the assumption that n_2 is positive, the derivative will be positive if $V(x)$ is larger than h .² Given this result, it is easily seen that the effect of an increase in $(i^* + E(x))$ on n_2 is positive, since

$$\frac{dn_2}{d(i^* + E(x))} = \frac{dn_2}{dh} \frac{dh}{d(i^* + E(x))} > 0, \text{ where } \frac{dh}{d(i^* + E(x))} = 1.$$

2. The assumption that $E(\tilde{e})$ is independent of e and remains unchanged may seem too strong. The conclusion in the text, however, will hold even when $E(\tilde{e})$ depends upon e , as long as the elasticity of $E(\tilde{e})$ with respect to e is smaller than 1.

3. Differentiating n_2 with respect to $V(x)$, we have

(continued)

Given the above results, the optimal composition of investment balances is specified as

$$\begin{aligned} n_1 &= n_1(i^* + E(x), i, V(x)) \quad \text{and} \\ n_2 &= n_2(i^* + E(x), i, V(x)) \end{aligned} \quad (14)$$

Taking into account $n_1 \equiv \hat{I}_j / I_j$ and $n_2 \equiv \hat{I}_j^* / I_j$, we can rewrite equation (14) as follows,

$$\hat{I}_j = n_1(i^* + E(x), i, V(x)) I_j \quad \text{and} \quad (15)$$

$$\hat{I}_j^* = n_2(i^* + E(x), i, V(x)) I_j \quad (16)$$

Adding transactions demand for monetary assets to investment demand, we obtain the following j -th individual's demand functions for domestic and foreign assets:

$$W_j = T_j + \hat{I}_j = kpy_j + n_1(i^* + E(x), i, V(x)) \hat{I}_j \quad (17)$$

$$W_j^* = \hat{I}_j^* = n_2(i^* + E(x), i, V(x)) I_j \quad (18)$$

where

W_j the j -th individual's demand for domestic monetary assets

W_j^* : the j -th individual's demand for foreign monetary assets.

Equations (17) and (18) represent the optimal composition of monetary wealth for the j -th individual who initially holds his entire wealth in domestic assets and maximizes the rate of return from assets diversification in domestic currency units.

$$\frac{dn_2}{dV(x)} = - \frac{2h(g-i)V(x)}{(V(x)^2 + h^2)^2} < 0$$

So far we have assumed that the j -th individual holds a certain amount of monetary wealth denominated in domestic currency and diversifies his assets holdings so as to maximize the expected value of utility, given an opportunity locus. Now, we consider the opposite case in which the j^* -th individual holds monetary wealth denominated in foreign currency and wants to diversify his assets holdings. This new assumption does not affect the basic line of the foregoing discussion, and the j^* -th individual's desired stock of domestic and foreign assets will be derived in the same way as the previous case. To see the point, let us assume that the j^* -th individual engages only in international transactions of goods and services denominated in foreign currency and that he needs an inventory of foreign assets for transactions purposes given by

$$T_{j^*}^* = k^* p^* y_{j^*}^* , \quad (19)$$

where

$T_{j^*}^*$: transactions demand for foreign assets by the j^* -th individual

p^* : foreign price

$y_{j^*}^*$: real volume of foreign transactions of the j^* -th individual

k^* : constant coefficient.

Then, denoting the j^* -th individual's total monetary wealth by $A_{j^*}^*$. we can specify his investment balances by

$$I_{j^*}^* = A_{j^*}^* - T_{j^*}^* = A_{j^*}^* - k^* p^* y_{j^*}^* , \quad (20)$$

where

$I_{j^*}^*$: the j^* -th individual's investment balances.

Like the previous case, the overall composition of the j^* -th individual's wealth will depend upon the asset composition of his investment balances. Assuming that he acts to diversify his investment balances

depending upon the rates of return on domestic and foreign assets, we can specify the yield from portfolio z^* as

$$z^* = n_1^*(i + x^*) + n_2^*i^* \quad \text{and} \quad (21)$$

$$n_1^* + n_2^* = 1 \quad , \quad (22)$$

where

n_1^* , n_2^* : ratios of investment demand for domestic and foreign assets to $I_{j^*}^*$, respectively

$$n_1^* \equiv \hat{I}_{j^*} / I_{j^*}^* \quad , \quad n_2^* \equiv \hat{I}_{j^*}^* / I_{j^*}^*$$

$\hat{I}_{j^*}$: the j^* -th individual's investment demand for domestic assets in foreign currency units

$\hat{I}_{j^*}^*$: the j^* -th individual's investment demand for foreign assets in foreign currency units

x^* : the expected rate of depreciation (if $x^* > 0$) or appreciation (if $x^* < 0$) of foreign currency

$$x^* \equiv s^*(\hat{e}^* - e^*)$$

e^* : the current exchange rate which is the inverse of e

$$e^* \equiv 1/e$$

$\hat{e}^*$: random variable for the future exchange rate which is the inverse of $\hat{e}$,

$$\hat{e}^* \equiv 1/\hat{e} \quad .$$

Given the return on portfolio z^* , the expected return and the risk of the portfolio is represented by

$$E(z^*) = n_1^*(i + E(x^*)) + n_2^*i^* \quad \text{and} \quad (23)$$

$$V(z^*) = n_1^*V(x^*) \quad , \quad (24)$$

where

$E(z^*)$: expected return on portfolio z^*

$V(z^*)$: risk of portfolio z^*

$E(x^*)$: expected value of the rate of change in the exchange rate

$$E(x^*) = s^*(E(\hat{e}^*) - e^*)$$

$E(\hat{e}^*)$: the expected value of the future exchange rate

$V(x^*)$: standard deviation of x^*

$$V(x^*) = s^{*2} V(\hat{e}^*)$$

$V(\hat{e}^*)$: standard deviation of $\hat{e}^*$.

Assuming that the j^* -th individual has the same type of utility function as the j -th individual, that he is a risk-averter and that he maximizes the expected value of utility, etc., we can express the optimal ratios of n_1^* and n_2^* as:¹

$$n_1^* = n_1^*(i + E(x^*), i^*, V(x^*)) \quad \text{and} \quad (25)$$

$$n_2^* = n_2^*(i + E(x^*), i^*, V(x^*)) \quad . \quad (26)$$

Following the same line of argument presented in the previous analysis n_1^* and n_2^* will have the following properties.

(a) As long as the standard deviation of the expected rate of depreciation of foreign currency ($V(x^*)$) is larger than the expected value of yield differential ($i + E(x^*) - i^*$), an increase (decrease) in yield on domestic assets ($i + E(x^*)$) relative to that of foreign assets (i^*) stimulates (reduces) demand for domestic assets and decreases (increases) demand for

1. Note that equations (25) and (26) are derived under the assumption that $i + E(x^*)$ is larger than i^* . If this assumption is not fulfilled, the maximization of the expected value of utility will occur at a corner and the j^* -th individual holds his entire wealth only in foreign assets.

foreign assets. Since $E(x^*)$ is defined as $E(x^*) = s^*(E(\hat{e}^*) - e^*)$, it follows that a depreciation (appreciation) of domestic currency causes the j^* -th individual to demand domestic (foreign) assets and reduce his holdings of foreign (domestic) assets by making the expected rate of appreciation of domestic currency larger (smaller) under a given expected future exchange rate ($E(\hat{e}^*)$).¹ Given the current exchange rate, the j^* -th individual's expectation that foreign currency will depreciate (appreciate) in future periods brings about an increase (decrease) in demand for domestic assets and a decrease (increase) in demand for foreign assets.

(b) An increase in the standard deviation of the expected rate of currency change ($V(x^*)$) leads to a fall in demand for domestic assets and a rise in demand for foreign assets by increasing the risk associated with the expected exchange rate change.

Taking into account transactions demand for foreign assets, we can obtain the optimal asset composition for the j^* -th individual by using conditions (25) and (26):

$$W_{j^*} = \hat{I}_{j^*} = n_1^*(i + E(x^*), i^*, V(x^*)) I_{j^*}^* \quad \text{and} \quad (27)$$

$$W_{j^*}^* = T_{j^*}^* + \hat{I}_{j^*}^* = k^* p^* y_{j^*}^* + n_2^*(i + E(x^*), i^*, V(x^*)) I_{j^*}^* \quad , \quad (28)$$

where

W_{j^*} : the j^* -th individual's demand for domestic monetary assets

$W_{j^*}^*$: the j^* -th individual's demand for foreign monetary assets.

(3) The Exchange Rate and The Aggregate Asset Equilibrium

So far discussion has been concerned with optimal asset demands by the representative individuals j and j^* . Each individual was assumed to hold initially only either domestic or foreign assets. The main argument developed under this assumption is still applicable in the case where an individual holds two national assets together. The modification needed

in such a case is to regard the individual as two different asset holders, each holding either domestic or foreign assets.

Aggregating demands for domestic and foreign assets given in equations (17), (18), (27) and (28), we can specify demands for the two national assets by the private sector as a whole as follows:

$$W = \sum W_j + e \sum W_{j^*} \quad (29)$$

$$= \sum k p y_j + \sum n_1 (i^* + E(x), i, V(x)) I_j + e \sum n_1^* (i + E(x^*), i^*, V(x^*)) I_{j^*}$$

$$W^* = \frac{1}{e} \sum W_j^* + \sum W_{j^*}^* \quad (30)$$

$$= \sum k^* p^* y_{j^*}^* + \sum n_2^* (i + E(x^*), i^*, V(x^*)) I_{j^*}^* + \frac{1}{e} \sum n_2 (i^* + E(x), i, V(x)) I_j$$

where

W : aggregate demand for domestic assets

W^* : aggregate demand for foreign assets.

Adding the supply condition of domestic and foreign assets to the demand conditions specified above, we obtain the following equilibrium conditions of domestic and foreign assets:

$$k p y + n_1 (i^* + E(x), i, V(x)) I + e n_1^* (i + E(x^*), i^*, V(x^*)) I^* = A \quad (31)$$

$$k^* p^* y^* + n_2^* (i + E(x^*), i^*, V(x^*)) I^* + \frac{1}{e} n_2 (i^* + E(x), i, V(x)) I = A^* \quad , \quad (32)$$

where

$$y \equiv \sum y_j \quad , \quad y^* \equiv \sum y_{j^*}^*$$

$$I \equiv \sum I_j \quad , \quad I^* \equiv \sum I_{j^*}^* \quad \text{and} \quad A \equiv \sum A_j \quad , \quad A^* \equiv \sum A_{j^*}^* \quad .$$

n_1 , n_2 , n_1^* , n_2^* , $E(x)$, $E(x^*)$, $V(x)$, and $V(x^*)$ now stand for aggregate parameters.

Equation (31) represents the equilibrium condition of domestic assets and equation (32) the equilibrium condition of foreign assets. Noting $I = A - kpy$ and $I^* = A^* - k^*p^*y^*$, we can rewrite the two equations as follows:

$$kpy + n_1(i^* + E(x), i, V(x))(A - kpy) + n_1^*(i + E(x^*), i^*, V(x^*))(A^* - k^*p^*y^*)e = A \quad \text{and} \quad (33)$$

$$k^*p^*y^* + n^*(i + E(x^*), i^*, V(x^*))(A^* - k^*p^*y^*) + n_2(i^* + E(x), i, V(x))(A - kpy)\frac{1}{e} = A^* \quad . \quad (34)$$

Two remarks are in order concerning the asset equilibrium conditions given by equations (33) and (34).

(a) If all individuals in the private sector consider that the rate of return on foreign assets is higher than that on domestic assets, n_1^* may be equal to zero (or $n_2^* = 1$), while n_2 is positive. In this case, domestic currency will depreciate until the rate of return on domestic assets becomes relatively high enough so that domestic as well as foreign assets are held willingly. On the other hand, if all individuals in the private sector consider that the rate of return on domestic assets is higher than that on foreign assets, n_2 may be equal to zero (namely $n_1 = 1$), while n_1^* is positive. In this case, domestic currency will appreciate until the rate of return on foreign assets becomes relatively high enough so that foreign as well as domestic assets are held willingly.

In general, however, neither n_2 nor n_1^* will become zero for two reasons. First, expectation of the future exchange rate will differ from individual to individual. It would be quite unlikely that all individuals held the same subjective expectation on the future exchange rate; some may expect the domestic currency to appreciate and others may have the opposite expectation. This will make the subjective yield differential of an individual different from that of others and tend to prevent n_2 and n_1^* from being equal to zero. Second, even if the (expected) rates of return

on domestic and foreign assets are equal to each other, the risk associated with the expected rate of exchange-rate change may differ from individual to individual. This factor will also tend to prevent n_2 and n_1^* from being equal to zero.

(b) Substituting $n_1 = 1 - n_2$ and $n_2^* = 1 - n_1^*$ into the two equations, we can transform them to the following equation,

$$n_2(i^* + E(x), i, V(x))(A - kpy) = n_1^*(i + E(x^*), i^*, V(x^*))(A^* - k^*p^*y^*)e \quad (35)$$

The transformation indicates that only one of equations (33) and (34) is an independent equilibrium condition by which the exchange rate is determined; if the demand and supply of domestic assets is in equilibrium, the demand and supply of foreign assets will also be in equilibrium.

(c) We can rewrite equation (35) in terms of the desired and actual ratios of the investment demand for foreign assets to that for domestic assets if we (i) substitute $E(x) = s(E(\bar{e}) - e)$, $E(x^*) = s^*(E(\bar{e}^*) - e^*)$, $e^* = 1/e$ and $\bar{e}^* = 1/\bar{e}$, (ii) replace $E(\bar{e})$ (and $E(\bar{e}^*)$) by the aggregate expected future exchange rate $\bar{e}$, and $V(x)$ (and $V(x^*)$) by the aggregate risk $\bar{v}$, and (iii) assume that both $(A - kpy)$ and $(A^* - k^*p^*y^*)$ are positive. That is,

$$F(e, i, i^*, \bar{e}, \bar{v}) = \frac{e(A^* - k^*p^*y^*)}{A - kpy} \quad (36)$$

where

$F = n_2/n_1^*$: the desired ratio of investment demand
for foreign assets to that for domestic assets

$$\frac{dF}{de} < 0, \frac{dF}{di} < 0, \frac{dF}{di^*} > 0, \frac{dF}{d\bar{e}} = -\frac{dF}{de} > 0, \frac{dF}{d\bar{v}} < 0 \quad (36)'$$

Note: The signs of the above partial derivatives are based upon those of the partial derivatives of n_2 and n_1^* with respect to e , i , i^* , $\bar{e}$, and $\bar{v}$.

It is assumed that the size of the partial derivative of F with respect to $\bar{e}$ is the same as that of F with respect to e with the opposite sign.

Equation (36) can alternatively be expressed in terms of rates of change of variables, as given by:¹

$$(1 - q_{F,e}) \frac{de}{e} = q_{F,i} \frac{di}{i} + q_{F,i^*} \frac{di^*}{i^*} - q_{F,e} \frac{d\bar{e}}{e} + q_{F,\bar{v}} \frac{d\bar{v}}{v} \\ + (r \frac{dA}{A} - (r-1) (\frac{dp}{p} + \frac{dy}{y})) - (r^* \frac{dA^*}{A^*} - (r^*-1) (\frac{dp^*}{p^*} + \frac{dy^*}{y^*})) \quad , \quad (37)$$

where

$q_{F,x}$: elasticity of F with respect to variable x

$$q_{F,e} < 0, \quad q_{F,i} < 0, \quad q_{F,i^*} > 0, \quad q_{F,\bar{v}} < 0, \quad \text{and} \quad (37)'$$

$$r = \frac{A}{A - kpy} > 0, \quad r - 1 = \frac{kpy}{A - kpy} > 0$$

$$r^* = \frac{A^*}{A^* - k^*p^*y^*} > 0, \quad r^* - 1 = \frac{k^*p^*y^*}{A^* - k^*p^*y^*} > 0 \quad .$$

Equation (36) (or (37)) represents the asset equilibrium condition for exchange rate determination based upon the portfolio approach. The condition shows that the equilibrium exchange rate depends upon a number of variables, such as the domestic and foreign interest rates, the nominal stocks of domestic and foreign monetary assets, the values of domestic and

1. Comparing the asset equilibrium condition for exchange rate determination given by equation (36) with the ones given by other authors such as H. Genberg and H. Kierzkowski, "Employment and Price Fluctuations under Flexible Exchange Rates," the Graduate Institute of International Studies (May 1975) and P.J.K. Kouri, "The Exchange Rate and the Balance of Payments in the Short-run and in the Long-run: A Monetary Approach," presented at the Seminar on Flexible Exchange Rates and Stabilization Policy, Stockholm (August 1975), it is apparent that equation (36) is different in two respects. First, the exchange rate appears not only in the supply side (in the present case $\frac{e(A^* - k^*p^*y^*)}{A - kpy}$) but also in the demand side (in the present case, $F(e, ---)$). Second, domestic and foreign prices constitute part of the determinants of the exchange rate through their effects on the transactions demand for monetary assets. The implication of these points is brought out later in this chapter in relation to the effect of a change in domestic money on the exchange rate.

foreign transactions, the expected exchange rate and risk. The effects of changes in the explanatory variables on the exchange rate are given by (36)' or (37)'. From them, it is readily seen that:

(i) an increase in the domestic interest rate leads to appreciation of domestic money by inducing an excess demand for domestic monetary assets, while an increase in the foreign interest rate leads to depreciation of domestic money by inducing an excess demand for foreign monetary assets;

(ii) an increase in the nominal stock of domestic assets leads to a depreciation of domestic money by creating an excess demand for foreign assets, while an increase in the nominal stock of foreign assets held by the private sector brings about the opposite effect on the exchange rate by creating an excess supply of foreign assets;

(iii) an increase in domestic price and the real volume of domestic transactions causes domestic money to appreciate by increasing the transactions demand for domestic assets, while an increase in foreign price and the real volume of foreign transactions alters the exchange rate in the opposite direction by raising the transactions demand for foreign assets;

(iv) a rise (fall) in the expected exchange rate, namely a fall (rise) in the expected external value of domestic money, causes foreign money to appreciate (depreciate) by raising the subjective rate of return on foreign (domestic) assets and thereby increasing the demand for them;

(v) an increase in the risk on foreign assets arising from uncertainty over the expected rate of exchange-rate change leads to appreciation of domestic money by reducing the demand for foreign monetary assets.

Three features of the above asset equilibrium condition for the exchange rate should be noted.

First, given elasticities $q_{F,i}$, q_{F,i^*} and $q_{F,v}$, the size of the effect of a change in the explanatory variables in equation (37) on the exchange rate depends significantly upon the elasticity of the investment demand for domestic and foreign monetary assets with respect to the expected

rate of change in the exchange rate (namely, $q_{F,e}$), as long as the expected exchange rate is different from the current rate. If the expected exchange rate is assumed to be determined independently of the current rate, it is readily seen that the stronger the effect of capital gains or losses arising from the non-zero expected rate of change in the exchange rate on the investment demand for domestic and foreign monetary assets (namely, the larger $q_{F,e}$), the smaller will be the impact of a change in the explanatory variables on the exchange rate. If the expected exchange rate is a function of the current rate, the size of the effect of a change in the explanatory variables on the exchange rate will depend upon how and to what extent expectation about the future exchange rate is influenced by the current exchange rate. However, the above conclusion will still hold as long as the expected future exchange rate is a positive function of the current rate and the elasticity of the former with respect to the latter is smaller than 1. On the other hand, if the private sector's expectation of the future exchange rate is such that the expected exchange rate is always equal to the current rate, the impact of a change in the explanatory variables on the current exchange rate will then become independent of $q_{F,e}$.¹

Second, domestic and foreign prices constitute part of the explanatory variables determining the exchange rate through their effect on the transactions demand for domestic and foreign monetary assets. As already mentioned, an increase in domestic price causes domestic money to appreciate by raising the transactions demand for domestic assets, while an increase in foreign price brings about the opposite effect on the exchange rate by increasing the transactions demand for foreign assets. The theoretical property that the exchange rate depends negatively upon domestic price is particularly important, since it implies that an increase in domestic monetary assets will have a smaller impact on the exchange rate if it is followed by an increase in domestic price. This is readily

1. This type of expectation will hold only in the long-run when the adaptive expectation hypothesis is assumed.

seen from equation (37). Suppose that domestic monetary assets increase by 10 per cent. Equation (37) shows that if domestic price remains unchanged, the increase in domestic monetary assets will make the exchange rate depreciate by $10r/(1-q_{F,e})$ per cent. If domestic price also increases as a result of the monetary expansion, the exchange rate depreciates less than $10r/(1-q_{F,e})$ per cent; the more domestic price increases, the less will the exchange rate depreciate.

Third, the two properties of equation (36) or (37): (i) the impact of a change in the explanatory variables on the exchange rate will be smaller as long as the expected exchange rate is a positive function of the current exchange rate with an elasticity smaller than 1; and (ii) the exchange rate is a negative function of domestic price, may combine to bring about the interesting theoretical possibility that an increase in domestic money may lead to a less than proportionate depreciation of the exchange rate if it is followed by an increase in domestic price equal to or larger than depreciation of domestic money.¹ To illustrate this, suppose that (i) interest-bearing domestic government securities do not form a part of the wealth effect so that the rate of increase in domestic money is equal to that of domestic monetary assets; (ii) the expectation of the future exchange rate is given by $(d\bar{e}/\bar{e}) = \lambda(de/e)$ (where, $0 < \lambda < 1$), and (iii) the domestic interest rate is determined by equation $(M/p) = L(y,i)$, namely, $(di/i) = (1/q_{L,i})((dM/M) - (dp/p)) - (q_{L,y}/q_{L,i})(dy/y)$.² Assuming for simplicity $(dy/y) = (dA^*/A^*) = (di^*/i^*) = (d\bar{v}/\bar{v}) = 0$ and substituting the above three conditions into (37), we obtain;

$$(1 - (1-\lambda)q_{F,e})\frac{de}{e} = (r + \frac{q_{F,i}}{q_{L,i}})\frac{dM}{M} - (r - 1 + \frac{q_{F,i}}{q_{L,i}})\frac{dp}{p} \quad (38)$$

1. This problem is related to the theoretical issue of whether or not the exchange rate overshoots the long-run equilibrium rate in the short-run as a result of a domestic monetary expansion. This is discussed more in detail in the next chapter.

In clarifying the following point, I am indebted to Professor H. Genberg.

2. It is assumed that $q_{L,i}$ is negative and $q_{L,y}$ is positive.

where

$$\frac{q_{F,i}}{q_{L,i}} > 0, \quad r - 1 > 0, \quad r + \frac{q_{F,i}}{q_{L,i}} > 1.$$

Now, suppose that an increase in domestic money results in an increase in domestic price, and that the rate of increase is equal to or larger than the rate of depreciation of the exchange rate, ie., $(dp/p) = (1 + \beta)(de/e)$ (where, $\beta \geq 0$). Substituting this equation into (38), we can rewrite equation (38) as follows

$$\left(r + \frac{q_{F,i}}{q_{L,i}} - (1-\lambda)q_{F,e} + \bar{U}\right) \frac{de}{e} = \left(r + \frac{q_{F,i}}{q_{L,i}}\right) \frac{dM}{M}, \quad (39)$$

where

$$\bar{U} \equiv (r - 1 + \frac{q_{F,i}}{q_{L,i}})\beta \geq 0.$$

Noting $q_{F,e}$ is negative, we can see that the rate of depreciation of domestic money is smaller than the rate of increase in domestic money as long as the conditions $0 < \lambda < 1$ and $\beta \geq 0$ are satisfied.

Assuming that in the long-run equilibrium neutrality of money holds and the expected exchange rate is equal to the current exchange rate (namely, $(de/e) = (d\bar{e}/\bar{e}) = (dp/p) = (dM/M)$), the above result suggests the exchange rate may undershoot the long-run equilibrium rate in the short-run as a result of an increase in domestic money.¹ Clearly, whether this result is theoretically possible or not depends upon how domestic price changes when domestic money increases as well as upon the features of the asset equilibrium condition for exchange rate determination which were mentioned above. That is, to complete the present argument, we must endogenize domestic price and explicitly specify its determination.

The purpose of this chapter was to derive the demand functions for

1. Definitions of short- and long-run equilibrium are made in the next chapter.

domestic and foreign monetary assets and to specify the main economic determinants of the exchange rate under the portfolio approach. This analysis was based upon the mean-variance approach to portfolio choice and showed the exchange rate to be a function of a number of variables such as the nominal stocks of domestic and foreign monetary assets, the domestic and foreign interest rates, the values of domestic and foreign transactions, the expected future exchange rate and risk. All the qualitative effects of those variables on the exchange rate were made theoretically clear. However, no a priori conclusions were obtained as to the quantitative magnitude of their effects. Therefore, an empirical study is both important and necessary for studying these effects.

In the next chapter I incorporate the reduced form equation for exchange rate determination given by (37) into a macro model and analyze the effects of domestic economic policy and external (real and monetary) disturbances under flexible exchange rates.

CHAPTER V

Asset Equilibrium and Monetary Adjustment Under Flexible Exchange Rates

In the previous chapter, I presented a detailed discussion of the economic determinants of the exchange rate in the analytical framework of the portfolio approach. The purpose of this chapter is to construct a macroeconomic model by integrating the asset equilibrium condition outlined in the previous chapter and to analyse the impact of macroeconomic policy and foreign (real and monetary) disturbances on the domestic economy under flexible exchange rates.

The macroeconomic model to be elaborated has the following features. First, the stock of wealth is regarded as an important determinant of savings by considering them as a reflection of the stock adjustment of wealth by the private sector. Since the balance of trade position of a country depends upon indirectly savings (or expenditure) the goods market equilibrium condition, the assumption implies that the stocks of monetary assets, such as domestic and foreign money, are crucial elements which determine adjustment of the balance of trade. Second, at variance with the standard theory, disequilibrium of the balance of trade is regarded in the present model as determining the rate of change in the stock of foreign assets held by the private sector. The balance of trade is assumed to induce a variation of the exchange rate not through affecting the flow demand and supply of foreign exchange, but through changing the stock of foreign assets and thereby bringing about a portfolio disequilibrium between domestic and foreign assets. Third, a change in the exchange rate is assumed to affect the adjustment of the balance of trade not only by changing the relative price between domestic and foreign goods but also by inducing a change in the real stock of wealth held by the private sector; that is, a variation of the exchange rate alters the balance of trade

position partly through the real wealth effect resulting from the change in the domestic price level. Finally, attention is paid to the dynamic monetary adjustment stemming from a change in the private sector's holdings of foreign assets due to disequilibrium of the balance of trade; disequilibrium of the balance of trade continuously affects the wealth stock of the private sector by changing the stock of foreign assets, which in turn has a repercussion on the balance of trade by inducing a change in the levels of saving and expenditure. If the system is stable, the private sector's wealth and adjustment will gradually eliminate disequilibrium of the balance of trade in the long-run. The detailed specification of the dynamic adjustment process is presented together with the long-run equilibrium condition.

The plan of this chapter is as follows. In section 1, I present the general assumptions which are used in the model. In section 2, I specify the monetary equilibrium condition based upon the asset equilibrium condition discussed in the previous chapter. In section 3, I present the equilibrium condition of the goods market under the assumptions of full employment and perfect price flexibility. In section 4, I specify two dynamic equations on the expectation of the future exchange rate and the accumulation of the stock of foreign assets, and make a distinction between short-run and long-run equilibrium. In section 5, using the model, I discuss the impact of monetary policy and foreign (real and monetary) disturbances on the exchange rate, domestic price, etc., and compare them to those derived from the standard approach. In the last section, I shall present brief concluding remarks.

(1) Assumptions

The world economy is composed of two countries: the home and foreign countries. The home country is assumed to be small in the sense that the foreign import price and interest rate are exogenously given. The home country produces, in full employment, goods which are not perfectly substitutable for import or foreign goods; the price level of the home-

produced goods is regarded as an endogenous variable which is determined by equilibrium of the goods market.

Domestic assets of the home country are composed of two types of monetary assets: money and short-term government securities. Foreign assets are also assumed to be composed of money and short-term interest-bearing assets. In the present case where the foreign interest rate is an exogenous variable, however, foreign monetary assets will be treated as composite assets which have the average rate of return i^* .

Domestic assets are assumed to be non-tradable in the sense that they are demanded only by the home country's residents and not by foreign residents. In contrast, foreign assets are assumed to be tradable: they are demanded not only by the home country's residents but also by foreign residents.

The government sector of the home country pursues a balanced budget policy. In addition, it does not intervene in the foreign exchange market to stabilize the external value of domestic currency.¹ Consequently, there is no continuous change in the stock of domestic assets, and the exchange rate is entirely determined by the free market forces. Finally, it is assumed that there is neither real capital accumulation nor growth of labour supply; that is, the following discussion is confined to the stationary state.

(2) Monetary Equilibrium

Monetary equilibrium of the present model consists of two portfolio equilibriums, which are given by equations (1) and (2),

$$F(e, i, i^*, \bar{e}, \bar{v}) = \frac{e(A^* - k^*p^*y^*)}{\bar{A} - kpy} \quad (1)$$

$$m = L(y, i, a) \quad (2)$$

where

1. In what follows money and currency will be used interchangeably.

e : exchange rate: price of a unit of foreign currency in terms of domestic currency units

i, i^* : domestic and foreign interest rates, respectively

y, y^* : domestic real income and real volume of trade (for example, imports), respectively, which are used as proxies for the volumes of domestic and foreign transactions

p, p^* : domestic and foreign prices, respectively

A, A^* : nominal stocks of domestic and foreign monetary assets held by the home country's private sector

$$A \equiv M + N, \quad A^* \equiv M^* + N^*$$

M : nominal stock of domestic money

N : nominal stock of domestic government securities

M^* : nominal stock of foreign money

N^* : nominal stock of foreign securities

$$m = (M/p), \quad \text{and} \quad a = (A/p)$$

$\bar{e}$: exchange rate which is expected currently for future periods

$\bar{v}$: risk associated with exchange rate changes

k, k^* : constant coefficients for transactions demand for domestic and foreign monetary assets, respectively.

Assuming equations (1) and (2) are linear functions in terms of logarithms, we can rewrite them as follows¹:

$$\begin{aligned} & -f_1 \log e - f_2 \log i + f_3 \log i^* + f_1 \log \bar{e} - f_4 \log \bar{v} \\ & = \log e + r^* \log A^* - (r^* - 1)(\log p^* + \log y^*) \\ & \quad - r \log A + (r - 1)(\log p + \log y) \end{aligned} \quad (1)'$$

$$\log m = -\hat{k}_1 \log i + \hat{k}_2 \log y + \hat{k}_3 \log a, \quad (2)'$$

where

$$f_1 > 0, \quad f_2 > 0, \quad f_3 > 0, \quad f_4 > 0$$

1. For the signs of the coefficients of equation (1)', see chapter 4.

$$\hat{k}_1 > 0, \quad \hat{k}_2 > 0, \quad 0 < \hat{k}_3 < 1$$

$r, r-1$: weights for the linearization of $\log(A-kpy)$

$$r > 0, \quad (r - 1) > 0$$

r^*, r^*-1 : weights for the linearization of $\log(A^*-k^*p^*y^*)$

$$r^* > 0, \quad (r^* - 1) > 0 \quad .$$

Equation (1) (and (1)') represents the portfolio equilibrium between domestic and foreign assets, by which the exchange rate is determined. The equation is presented in terms of equality between the desired and the actual ratios of foreign to domestic investment balances.¹ As already discussed in chapter 4, an increase in the stock of domestic assets and the foreign interest rate makes the domestic currency depreciate by creating an excess demand for foreign assets, while an increase in the stock of foreign assets and the domestic interest rate brings about the opposite effect on the external value of the domestic currency by inducing an excess demand for domestic assets. An increase in domestic nominal income raises the external value of domestic money by leading to an increase in the transactions demand for domestic monetary assets, while an increase in the value of foreign transactions lowers it by bringing about an increase in the transactions demand for foreign monetary assets. A fall (rise) in the expected exchange rate (namely, a rise (fall) in the expected external value of domestic money under the present definition of the exchange rate) induces an excess demand for domestic (foreign) assets by raising the subjective rate of return on them, and results in a depreciation (appreciation) of foreign currency. Finally, an increase in the risk of holding foreign assets associated with exchange rate changes reduces the demand for foreign assets and makes the domestic currency appreciate.

1. For the derivation of equation (1), see chapter 4.

Equation (2) (and (2)') represents the portfolio equilibrium between domestic money and domestic government securities, by which the domestic interest rate is determined. An increase in the quantity of domestic money lowers the domestic interest rate by creating an excess demand for government securities, while an increase in the real income and the domestic price brings about the opposite effect on the domestic interest rate by creating an excess demand for domestic money.

To facilitate the discussion in what follows, I modify the specification of the two equations by introducing some additional assumptions. First, I assume for simplicity that the weights for A and kpy in the linearization of $\log (A - kpy)$ are equal to those for A^* and $k^*p^*y^*$ in the linearization of $\log (A^* - k^*p^*y^*)$, namely, $r = r^*$ and $(r-1) = (r^*-1)$; that is, a change in the stock of domestic assets affects the exchange rate by the same proportion (but in the opposite direction) as a change in the stock of foreign does; and the same property holds between the effects of changes in domestic and foreign prices on the exchange rate. Second, I assume that y^* is a constant fraction of y (namely, $y^* = \theta y$ where $0 < \theta < 1$), and that the risk element associated with the expected rate of exchange-rate change is constant. Third, I assume that domestic government securities do not have the net wealth effect; that is, the positive wealth effect which may be brought about by the holdings of government securities is offset by the negative wealth effect which arises from the tax liability that the private sector has to bear in the future.¹ Consequently, domestic money and foreign assets alone are regarded as having the net wealth effect.

Given those additional assumptions, we can rewrite equations (1)' and (2)' as follows:¹

1. For this assumption, see R.A. Mundell, Monetary Theory: Inflation, Interest, and Growth in the World Economy (Good Year: California, 1971).

$$(1+f_1)\log e = f_1 \log \bar{e} - f_2 \log i + f_3 \log i^* \quad (3)$$

$$+ r(\log M - \log A^*) - (r-1)(\log p - \log p^*)$$

$$f_1 > 0, f_2 > 0, f_3 > 0, f_4 > 0, r > 0, (r-1) > 0$$

$$\log i = -k_1(\log M - \log p) + k_2 \log y \quad (4)$$

$$k_1 = (1-k_3)/\hat{k}_1 > 0, \quad k_2 = \hat{k}_2/\hat{k}_1 > 0.$$

Thus, given the stocks of domestic money and foreign assets, domestic and foreign prices, and the foreign interest rate, equations (3) and (4) determine the exchange rate and the domestic interest rate simultaneously. To focus our discussion on the exchange rate and the domestic price, let us eliminate the domestic interest rate from the two equations. Then, we obtain a relationship between the exchange rate and the domestic price, which is shown by the VV schedule in Figure 1.²

1. Equation (4) is transformed from equation (2)' under the assumption that domestic securities do not have the wealth effect, namely, $\log a = \log m$. It should be noted that the income term is dropped from equation (3) since $\log y - \log y^* = -\log \theta$, and the constant terms in equations (3) and (4) are omitted for simplicity.

In what follows, all variables and equilibrium conditions in the model will be defined in terms of logarithm. Price units (including the exchange rate) are assumed to be chosen in such a way that their logarithmic values are positive.

2. Eliminating $\log i$ from equations (3) and (4), we have the following equation which represents the VV schedule.

$$(1+f_1)\log e + (f_2 k_1 + r-1)\log p = f_1 \log \bar{e} + (f_2 k_1 + r)\log M \quad (i)$$

$$- r \log A^* + (r-1)\log p^* + f_3 \log i^* - f_2 k_2 \log y$$

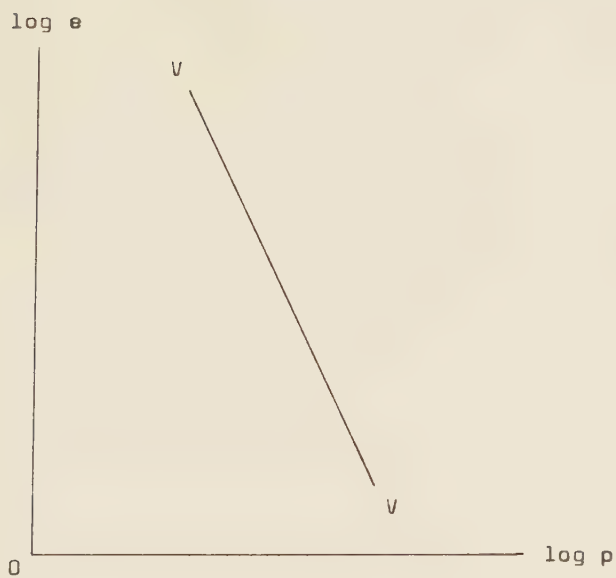
Equation (i) thus gives us the following partial derivative of $\log e$ with respect to $\log p$

$$\left(\frac{d \log e}{d \log p} \right)_{VV} = - (f_2 k_1 + r-1) / (f_1 + 1).$$

$\frac{d}{d}$ stands for partial differentiation.

As all parameters are assumed to have positive signs, it is readily seen that the above partial derivative is negative.

Figure 1



The VV schedule has a negative slope for two reasons. First, an increase in the domestic price makes the domestic currency appreciate directly by increasing the transactions demand for domestic monetary assets and thereby creating an excess demand for them. Second, it raises the domestic interest rate by reducing the real stock of domestic money, which also leads to an excess demand for domestic assets and results in an appreciation of the domestic currency.

Needless to say, the position of the VV schedule depends upon the exogenous variables in the equations (3) and (4). For example, an increase in the quantity of domestic money will shift the VV schedule upwards since it makes the domestic currency depreciate at a given level of domestic price by lowering the domestic interest rate on the one hand and by increasing directly the demand for foreign assets on the other.¹ An increase in the stock of foreign assets will shift the VV schedule downwards since it brings about an excess demand for domestic assets and makes the domestic currency appreciate at a given domestic price level.² A fall (rise) in the expected exchange rate will shift the VV schedule downwards (upwards) because it lowers the expected rate of return on foreign (domestic) assets and increases the demand for domestic (foreign) assets.³ An increase in the foreign price will shift the VV schedule upwards by raising the transactions demand for foreign liquid assets and making the domestic currency depreciate at a given domestic price level.⁴

-
1. The partial derivative of $\log e$ with respect to $\log M$ is given by:

$$\left(\frac{d \log e}{d \log M}\right)_{VV} = (f_2 k_1 + r) / (f_1 + 1) > 0 .$$

2. Differentiating partially equation (i) with respect to $\log A^*$, we obtain:

$$\left(\frac{d \log e}{d \log A^*}\right)_{VV} = -r / (f_1 + 1) < 0 .$$

3. The partial derivative of $\log e$ with respect to $\log \bar{e}$ is given by:

$$\left(\frac{d \log e}{d \log \bar{e}}\right)_{VV} = f_1 / (f_1 + 1) > 0 .$$

4. Differentiating equation (i) partially with respect to $\log p^*$, we
(Continued)

(3) Equilibrium of the Goods Market

In addition to the monetary equilibrium condition, we must specify the equilibrium condition of the goods market. In the present model, the domestic price is an endogenous variable which is determined by equilibrium of the goods market, since the home-produced goods are assumed not to be perfectly substitutable for foreign goods. Equilibrium of the goods market requires the aggregate supply to be equal to the aggregate demand which is composed of the private and the government sectors' expenditure and the balance of trade. Thus, the equilibrium condition will be given by the following equation:

$$\log y = y_p + z_g + b_t \quad (5)$$

where

$\log y$: real income of the home country in terms of
logarithm

z_p : real expenditure by the private sector in terms of
logarithm

z_g : real expenditure by the government sector in terms
of logarithm

b_t : the balance of trade in terms of logarithm.

The goods market flow equilibrium can be alternatively viewed as a mechanism which aligns the private sector's desired accumulation of new assets with their flow supply by the government and the foreign sector, when the budget constraints of the private and government sectors are explicitly introduced. Suppose that the private sector pays tax t in real value (in terms of logarithm), spends part of its disposable income on the purchase of goods, and saves the rest of it. Suppose also that the government sector finances its spending entirely by tax from the private sector. Then the two sectors' budget constraints are given by the

obtain:

$$\left(\frac{d \log e}{d \log p^*} \right)_{vv} = (r-1)/(f_1+1) > 0 \quad .$$

following identities:

* private sector's budget constraint

$$\log y = z_p + s + t \quad (6)$$

* government sector's budget constraint

$$t \equiv z_g, \quad (7)$$

where

s : real saving by the private sector in terms of logarithm

t : real tax paid by the private sector in terms of logarithm .

Eliminating z_p and z_g in equation (5) by substituting equations (6) and (7), we can rewrite the equilibrium condition of the goods market as:

$$s = b_t . \quad (8)$$

Equation (8) indicates that under the assumption that the government sector pursues a balanced budget policy, the accumulation of new assets is made entirely in foreign monetary assets and the rate of accumulation of foreign monetary assets is determined by the level of saving.

To complete the specification of the equilibrium condition of the goods market, it is necessary to specify the saving function and the balance of trade. As for the saving function, it will be assumed that saving is a positive function of the difference between the desired and the actual stocks of wealth; the private sector accumulates wealth when the actual stock of wealth is smaller than the desired level and reduces it when the actual stock is larger than the desired level; and the desired real stock of wealth is assumed to be a positive function of real income.¹ Noting that the stock of wealth consists of domestic and foreign monetary assets in the present model, we can specify the saving function as:

1. A similar type of the saving function was also presented in chapter 2. See chapter 2.

$$s = h(\log \hat{w} - \log \bar{w}) , \quad (9)$$

where

$\log \hat{w}$: desired real wealth stock in terms of logarithm

$$\log \hat{w} \equiv h_1 \log y \quad (h_1 > 0)$$

$\log w$: existing real stock of wealth in terms of logarithm

$$\log w \equiv \log (m + qa^*) \quad q \equiv (ep^*/p)$$

$$a^* \equiv (A^*/p^*)$$

h : a coefficient which represents the adjustment speed at which the private sector adjusts its real wealth stock when there is a divergence between the desired and actual stocks of wealth

$$h > 0 .$$

On the other hand, the balance of trade is assumed to be a function of the terms of trade and real income.¹ It is assumed that an increase in the foreign relative to the domestic price improves the balance of trade through the substitution effect, and a decrease in the foreign relative to the domestic price leads to the opposite result.² Real income is assumed to have a negative relation with the balance of trade: an increase (decrease) in real income brings about a deficit (surplus) of the balance of trade by increasing (reducing) imports. Thus, we can specify the balance of trade as:

$$b_t = c_1 \log q - c_2 \log y + R \quad (10)$$

$$(c_1 > 0, c_2 > 0) ,$$

where

$\log q$: relative price between the home and the foreign country
 $\log q \equiv \log e + \log p^* - \log p$

R : shift parameter .

1. Strictly speaking, the balance of trade will be a function of the terms of trade and domestic absorption. In the present case, domestic absorption

(For footnote 2, see overleaf.)

Combining equations (9) and (10), we have the following equilibrium condition for the goods market:

$$h(h_1 \log y - \log w) = c_1 \log q - c_2 \log y + R \quad (11)$$

From equation (11), we can derive a positive relation between the domestic price and the exchange rate, which is shown by the XX schedule in Figure 2. The XX schedule has a positive slope since an increase in the domestic price reduces effective demand by lowering the real stock of wealth on the one hand, and by shifting demand away from domestic to foreign goods through the substitution effect on the other. In order for the goods market to be maintained in equilibrium, therefore, the exchange rate is required to depreciate so as to shift demand away from foreign to domestic goods through the relative price effect and to offset the decrease in demand for domestic goods brought about by an increase in the domestic price.¹

is replaced by real income to avoid some complexities arising from the introduction of absorption in the balance of trade. However, none of the discussion in what follows is affected by the assumption.

2. (ref: page 98) This implies that the sum of price elasticities of exports and imports is larger than unity.

1. Taking into account $\log q = \log e + \log p^* - \log p$ and $\log w = \log(M + eA^*) - \log p$, we can transform equation (11) to the following equation:

$$\begin{aligned} & (c_1 + u_2 h) \log e - (c_1 + h) \log p \\ &= -u_1 h \log M - u_2 h \log A^* - c_1 \log p^* + (c_2 + h_1 h) \log y - R, \end{aligned}$$

where

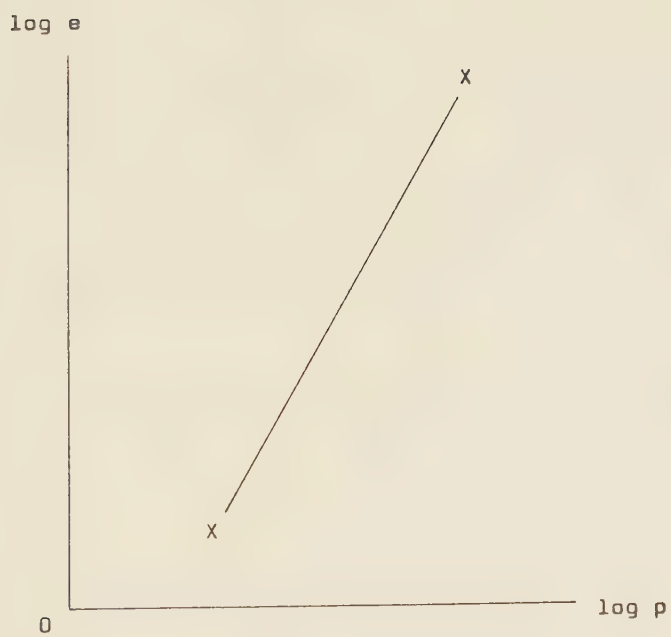
u_1 and u_2 represent the weights of the linearization of $\frac{\log(M + eA^*)}{\log(M + eA^*)}$, namely,

$$\begin{aligned} \log(M + eA^*) &= u_1 \log M + u_2 \log(eA^*) \\ (u_1 + u_2 &= 1, u_1 > 0, u_2 > 0) \end{aligned}$$

Dividing the above equation by $(c_1 + u_2 h)$, we obtain:

$$\begin{aligned} \log e - d_1 \log p &= -d_2 \log M - d_3 \log A^* - d_4 \log p^* \\ &+ d_5 \log y - d_6 R, \end{aligned} \quad (ii)$$

Figure 2



Like the VV schedule, the position of the XX schedule depends upon a number of exogenous variables, such as the stocks of domestic and foreign assets, real income and foreign price. An increase in domestic money and foreign assets shifts the XX schedule rightwards, since it stimulates domestic expenditure by increasing the real stock of wealth, and raises the domestic price level at a given exchange rate.¹ An increase in the foreign price also shifts the XX schedule rightwards because it switches the private sector's expenditure away from foreign to domestic goods through the substitution effect and makes the domestic price higher at a given level of the exchange rate.² Finally, an increase in exports (due

where

$$d_1 = (c_1 + h) / (c_1 + u_2 h), \quad d_2 = u_1 h / (c_1 + u_2 h)$$

$$d_3 = u_2 h / (c_1 + u_2 h), \quad d_4 = c_1 / (c_1 + u_2 h)$$

$$d_5 = (c_2 + h_1 h) / (c_1 + u_2 h), \quad d_6 = 1 / (c_1 + u_2 h)$$

$$d_1 > 1, \quad 0 < d_2, \quad d_3, \quad d_4 < 1, \quad d_5 > 0, \quad d_6 > 0$$

$$d_1 = d_2 + d_3 + d_4, \quad d_2 = d_1 - 1, \quad d_3 + d_4 = 1.$$

Equation (ii) gives us the following partial derivative of $\log e$ with respect to $\log p$:

$$\left(\frac{d \log e}{d \log p} \right)_{XX} = d_1 > 1.$$

Thus, it is readily seen that the XX schedule has a positive slope which is larger than 1.

1. From equation (ii), we obtain the following partial derivatives of $\log p$ with respect to $\log M$ and $\log A^*$:

$$\left(\frac{d \log p}{d \log M} \right)_{XX} = (d_2 / d_1) > 0, \text{ but smaller than } 1,$$

$$\left(\frac{d \log p}{d \log A^*} \right)_{XX} = (d_3 / d_1) > 0, \text{ but smaller than } 1.$$

These partial derivatives indicate that an increase in domestic money and foreign assets shifts the XX schedule rightwards.

2. The effect of a change in foreign price on the XX schedule is given by the following partial derivative:

(Continued)

to an exogenous increase in foreign income) shifts the XX schedule rightwards by increasing demand for home-produced goods and thereby raising the domestic price more at a given level of the exchange rate.¹

(4) Short-run and Long-run Equilibrium

The VV and XX schedules combine to determine the equilibrium exchange rate and domestic price in the short-run which are given by Q in Figure 3.² Although it is not explicitly shown in Figure 3, the domestic interest rate is also determined at the same time, corresponding to the exchange rate and domestic price given at Q . Point Q is termed the short-run equilibrium for two reasons. First, the desired level of wealth may not be necessarily equal to its actual stock and the balance of trade may not be in equilibrium; a trade surplus (deficit) will increase (decrease) the stock of foreign monetary assets held by the private sector of the home country, and consequently will shift the VV schedule downwards (upwards) by creating an excess supply of (demand for) foreign assets on the one hand, and the XX schedule rightwards (leftwards) by raising (lowering)

$$\left(\frac{d \log p}{d \log p^*}\right)_{XX} = (d_4/d_1) > 0, \text{ but smaller than } 1.$$

1. The effect of an exogenous change in exports on the XX schedule is given by the following partial derivative of $\log p$ with respect to shift parameter R :

$$\left(\frac{d \log p}{d R}\right)_{XX} = (d_6/d_1) > 0.$$

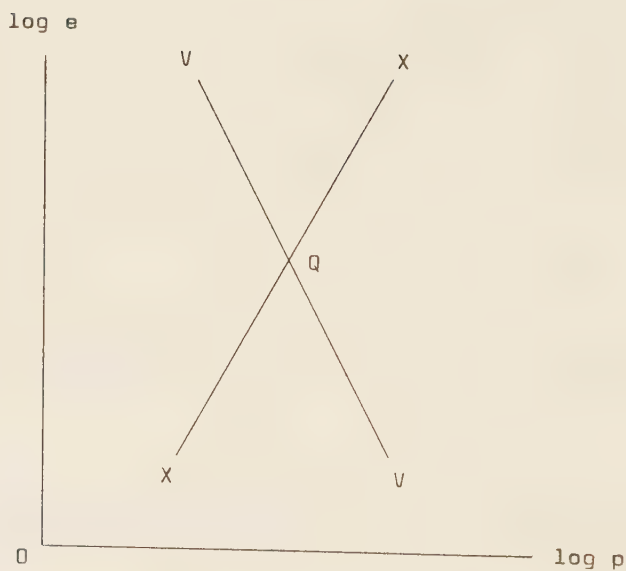
2. The short-run equilibrium values of the exchange rate and domestic price are obtained by solving equations (i) and (ii) with respect to $\log e$ and $\log p$, given $\log \bar{e}$, $\log A^*$, and other exogenous variables. They are given by:

$$\begin{aligned} \log e = & \left(\frac{1}{D_S}\right) (d_1 f_1 \log \bar{e} - (D_S - d_1 f_1) \log M - (d_1 r + d_3 (f_2 k_1 + r - 1)) \log A^* \\ & + ((d_1 - d_4) (r - 1) - d_4 f_2 k_1) \log p^* - d_6 (f_2 k_1 + r - 1) R + \text{----}) \end{aligned} \quad (\text{iii})$$

$$\begin{aligned} \log p = & \left(\frac{1}{D_S}\right) (f_1 \log \bar{e} + (D_S - f_1) \log M + (d_3 (f_1 + 1) - r) \log A^* \\ & + (d_4 (f_1 + 1) + r - 1) \log p^* + d_6 (f_1 + 1) R + \text{----}) \end{aligned} \quad (\text{iv})$$

(Continued)

Figure 3



effective demand for domestic goods on the other. Second, the private may continuously revise its expectations about what it considers to be a "long-run exchange rate" if there exists a divergence between the expected and the current exchange rates; a fall (rise) in the expected exchange rate, namely, a rise (fall) in the expected external value of domestic money, will raise the expected rate of return on domestic (foreign) assets, and push the VV schedule downwards (upwards). Thus, if there exists a balance-of-trade disequilibrium and the expectation on the future exchange rate is continuously revised, the exchange rate, the domestic price and interest rate will also change over time. The adjustment of the variables will continue until the full or long-run equilibrium is attained, where the balance of trade is in equilibrium and the expected exchange rate is equal to the current rate.

Thus, in order to take into account the adjustment to the long-run equilibrium, we need to introduce two dynamic equations; one specifies how the expectation of the exchange rate is formed and the other relates a change in the stock of foreign monetary assets to the balance of trade.

As for the dynamic equation for the expectation formation on the exchange rate in future periods, I assume that economic units take a past exchange rate into account when they form their expectations about what they consider to be a long-run exchange rate.¹ Suppose, for example, that

where

$$D_S \equiv d_1(f_1 + 1) + f_2 k_1 + (r - 1).$$

Note that the short-run equilibrium defined here is equivalent to the "instantaneous equilibrium" in W.H. Branson, "Macroeconomic Equilibrium with Portfolio Balance in Open Economies," *Institute for International Economic Studies, Stockholm* (November 1972).

1. An interesting attempt to incorporate the rational expectation hypothesis with the macro model of flexible exchange rates is made by R. Dornbush, "Exchange Rate Dynamics," Working paper, No. 167, Dept. of Economics of Massachusetts Institute of Technology (November 1975); M. Mussa, "Real and Monetary Factors in a Dynamic Theory of Foreign Exchange," *International Monetary Research Programme, London School of Economics* (June 1976).

economic units consider the long-run exchange rate to be $\bar{e}_x$ and that they observe that the exchange rate is e_x , which is different from the expected exchange rate $\bar{e}_x$. What the present hypothesis implies is that economic units will only partly revise what they consider to be a long-run exchange rate, namely, they do not immediately believe that the present exchange rate is permanent. This expectation hypothesis, which is generally termed the adaptive expectation model, can be expressed in terms of the following differential equation:

$$\frac{d \log \bar{e}}{dt} = K(\log e - \log \bar{e}) \quad , \quad (12)$$

where

K : expectation coefficient which is assumed to be greater than zero.

On the other hand, the dynamic equation for the accumulation of foreign monetary assets is given by:¹

$$\frac{d \log A^*}{dt} = G(b_t) \quad , \quad (13)$$

where

$$G(0) = 0 \quad \text{and} \quad G'(b_t) > 0 \quad .$$

1. It should be noted that the rate of change in the stock of foreign assets held by the private sector depends not only upon the balance of trade but also interest revenues from the holdings of foreign assets. In specifying equation (13), the latter is neglected to simplify the analysis in what follows. It should be also noted that, strictly speaking, the rate of change in the stock of foreign assets held by the private sector is a function of the nominal value of the balance-of-trade position (in terms of foreign currency units) rather than the real value as equation (13) shows. The present specification is taken mainly to avoid some complexities arising from the effect of a nominal change in the balance-of-trade position on the rate of change in the stock of foreign assets. However, none of the analysis in what follows is affected by this, as long as the stability condition, which is to be presented later, is fulfilled.

Thus, the specification of the long-run equilibrium requires that the following two conditions be added:

$$\frac{d \log \bar{e}}{dt} = K(\log e - \log \bar{e}) = 0$$

namely, $\log \bar{e} = \log e$, and (14)

$$\frac{d \log A^*}{dt} = G(b_t) = 0, \text{ namely, } b_t = 0. \quad (15)$$

If we take into account the equilibrium condition of the goods market given by equation (8), condition (15) means

$$b_t = 0, \text{ and } s = 0. \quad (16)$$

Thus, in the long-run equilibrium, the expected future exchange rate and the stock of foreign assets held by the private sector become endogenous variables which are determined together with the exchange rate, the domestic price and interest rate.¹

1. Given equilibrium conditions (14) and (16), the long-run equilibrium exchange rate, domestic price and stock of foreign monetary assets are determined by the following three equations:

$$\log e + (f_2 k_1 + r - 1) \log p + r \log A^* = (f_2 k_1 + r) \log M + (r - 1) \log p^* + f_3 \log i^* - f_2 k_2 \log y \quad (v)$$

$$c_1 \log e - c_1 \log p = -c_1 \log p^* + c_2 \log y - R \quad (vi)$$

$$u_2 \log e - \log p + u_2 \log A^* = -u_1 \log M + h_1 \log y. \quad (vii)$$

Equation (v) represents the long-run VV schedule, which is characterized by the condition $\log e = \log \bar{e}$. Equation (vi) represents the zero-balance-of-trade condition, and equation (vii) the long-run level of saving, which is also equal to zero. The long-run value of the domestic interest rate is obtained by substituting the long-run level of the domestic price into equation (4). As will be seen, neutrality of money holds in the long-run equilibrium.

The adjustment process to the long-run equilibrium in terms of the expected exchange rate and the stock of foreign assets is illustrated by the use of Figure 4. Along the EE schedule which traces the locus of the expected exchange rate and the stock of foreign monetary assets, the expected future exchange rate is equal to the current rate. This curve has a negative slope because an increase in the stock of foreign assets makes the domestic currency appreciate by creating an excess supply of foreign monetary assets. This means that an increase in the stock of foreign assets must be accompanied by a fall in the expected exchange rate in order for equilibrium of the expectation on the exchange rate to be maintained.¹

On the other hand, the A*A* schedule traces the locus of the expected exchange rate and the stock of foreign assets held by the private sector at which the balance of trade is in equilibrium. This schedule has a positive slope because a decline of the expected external value of the

1. Substituting equation (iii) on page 119 into equation (12), we obtain:

$$\frac{d \log \bar{e}}{dt} = \left(\frac{K}{D_S} \right) (-B_1 \log \bar{e} - B_2 \log A^* + B_3 \log M + B_4 \log p^* - B_5 R + \text{-----}) , \quad \text{(viii)}$$

where

$$B_1 \equiv D_S - d_1 f_1 > 0 ,$$

$$B_2 \equiv d_1 r + d_3 (f_2 k_1 + r - 1) > 0$$

$$B_3 \equiv B_1 > 0$$

$$B_4 \equiv (d_1 - d_4) (r - 1) - d_4 f_2 k_1 \geq 0$$

$$B_5 \equiv f_2 k_1 + r - 1 > 0$$

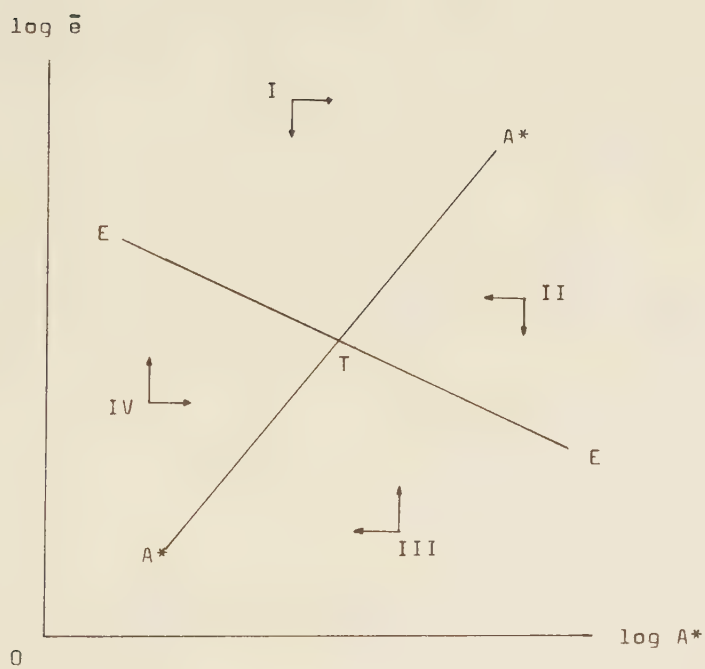
$$D_S \equiv d_1 (f_1 + 1) + f_2 k_1 + (r - 1) .$$

Setting equation (viii) equal to zero, we have:

$$\log \bar{e}_{EE} = - (B_2/B_1) \log A^* + (B_3/B_1) \log M + (B_4/B_1) \log p^* - (B_5/B_1) R + \text{-----} . \quad \text{(ix)}$$

It is readily seen from equation (ix) that the EE schedule has a negative slope. It should be noted that, in plotting the EE schedule, it is assumed that d_2 is equal to d_3 , namely, $u_1 = u_2$. Under this assumption, (B_2/B_1) is always smaller than 1.

Figure 4



domestic currency leads to a depreciation of the current exchange rate by creating an excess demand for foreign assets, which induces a trade surplus by making the import price higher relative to the price of home-produced goods. Consequently, in order for the balance of trade to remain in equilibrium, the decline in the expected external value of the domestic currency must be associated with an increase in the stock of foreign assets so that the effective demand for domestic goods is stimulated and the depreciation of the exchange rate is offset by a rise in the domestic price.¹

Given the dynamic equations, it is readily seen that a trade deficit will occur and the stock of foreign monetary assets will decrease at any point below and to the right of the A^*A^* schedule; a balance of trade

1. Substituting log e and log p given by equations (iii) and (iv) into equation (13), we obtain:

$$\frac{d \log A^*}{dt} = G \left(\frac{1}{D_S} (c_1 H_1 \log \bar{e} - c_1 H_2 \log A^* - c_1 H_3 \log M + c_1 H_4 \log p^* + H_5 R + \text{-----}) \right), \quad (x)$$

where

$$H_1 \equiv d_2 f_1 > 0,$$

$$H_2 \equiv d_2 r + d_3 D_Z > 0$$

$$H_3 \equiv H_1 > 0,$$

$$H_4 \equiv d_2 (d_4 (f_1 + 1) + r - 1) + (1 - d_4) D_S > 0$$

$$H_5 \equiv (1 - c_1 d_6) D_S + c_1 d_2 (f_1 + 1) > 0$$

$$D_S \equiv d_1 (f_1 + 1) + f_2 k_1 + (r - 1)$$

$$D_Z \equiv f_1 + f_2 k_1 + r = D_S - d_2 (f_1 + 1).$$

Setting equation (x) equal to zero,

$$\log \bar{e} \Big|_{A^*A^*} = (H_2/H_1) \log A^* + (H_3/H_1) \log M - (H_4/H_1) \log p^* - (H_5/H_1) R + \text{-----} . \quad (xi)$$

It is easily seen from equation (xi) that the A^*A^* schedule has a positive slope. It should be noted that, in plotting the A^*A^* schedule, d_2 is assumed to be equal to d_3 , namely, $u_1 = u_2$. Under this assumption, the slope of the A^*A^* schedule is always larger than 1.

surplus will occur and the stock of foreign assets will increase at any point above and to the left of the A^*A^* schedule; on the other hand, the expected exchange rate will rise at any point below and to the left of the EE schedule and fall at any point above and to the right of the EE schedule.

These dynamic responses are described by the arrows in Figure 4. Given the dynamic properties of the two differential equations, the expected exchange rate and the stock of foreign assets will move in the directions indicated by the arrows in each quadrant from any of points I, II, III and IV. It is seen that one of the arrows always points in the direction of the equilibrium T from any of the points in the diagram, which suggests that T is a stable equilibrium. Although the equilibrium may be approached cyclically depending upon the coefficients in the model, the discussion in what follows will be made under the assumption that the approach to the equilibrium is asymptotical.¹

1. The present model is always stable under the assumed signs of the coefficients in the system. This can be shown by linearizing equation (x) and calculating the following characteristic equation:

$$\begin{vmatrix} -\left(\frac{K}{D_S}\right)B_1 - \lambda & -\left(\frac{K}{D_S}\right)B_2 \\ \left(\frac{G'}{D_S}\right)c_1H_1 & -\left(\frac{G'}{D_S}\right)c_1H_2 - \lambda \end{vmatrix} = \lambda^2 + J_1\lambda + J_2 = 0,$$

where

$$J_1 \equiv (KB_1 + G'c_1H_2)/D_S > 0$$

$$J_2 \equiv c_1G'K(B_1H_2 + B_2H_1)/D_S^2 > 0.$$

The stability condition requires both J_1 and J_2 to be positive, which is fulfilled in the present case. The system, however, approaches equilibrium directly (asymptotically) or cyclically, depending upon whether

$$J = J_1^2 - 4J_2$$

is positive or negative; if J is positive, the above characteristic equation has real roots and the system leads directly (Continued)

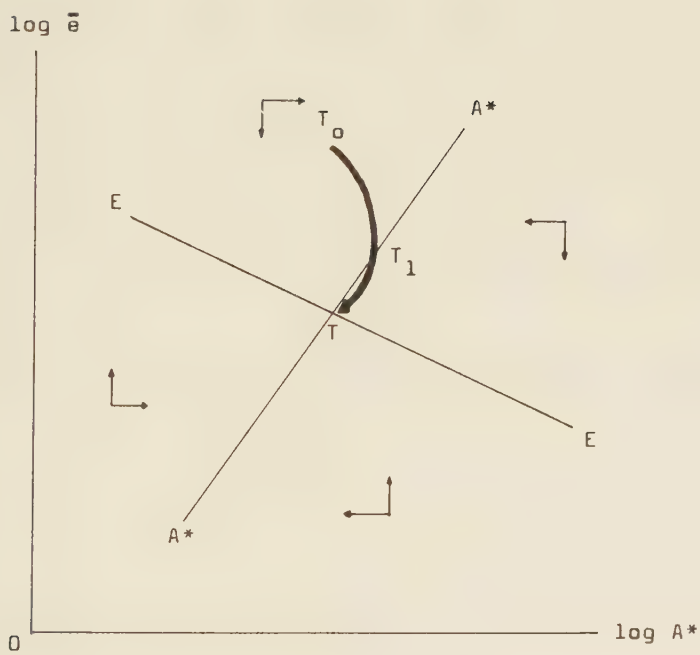
To illustrate adjustment to equilibrium, suppose that the system was initially in the long-run equilibrium at point T_0 , and a change in an exogenous variable shifts the EE and A^*A^* schedules downwards up to the position shown in Figure 5. The home country will have a surplus on the balance of trade and the expected exchange rate will fall (namely, the expected external value of domestic money rises) at point T_0 . The adjustment path to equilibrium T is represented, for example, by the curve T_0T . It means that the expected exchange rate continuously falls until the system reaches point T, while the balance of trade, which is initially in surplus, turns into a deficit on its way to the long-run equilibrium T as indicated by the T_0T curve's crossing over the A^*A^* schedule at point T_1 . Corresponding to these adjustments of the expected exchange rate and the stock of foreign monetary assets, the exchange rate, the domestic price and interest rate will also change over time until the long-run equilibrium is achieved.

(5) Portfolio Equilibrium and Monetary Adjustment under Flexible Exchange Rates

In the previous section, the short-run and long-run properties of the present model were presented. Equations (3), (4) and (11) combine to determine the exchange rate, the domestic price and interest rate in the short-run, given levels of the expected exchange rate, the stock of foreign assets and other exogenous variables. The short-run equilibrium position thus determined changes continuously along the path set by the dynamic equations (12) and (13) until the long-run equilibrium is attained. Using the model, we can analyse the impact of monetary policy, foreign real and monetary disturbances, etc., on the exchange rate, the domestic price and interest rate under flexible exchange rates.

(asymptotically) to equilibrium; if J is negative, the characteristic equation has complex roots and the approach to equilibrium is oscillatory.

Figure 5



- (a) The effect of monetary policy on the domestic price and the exchange rate

Suppose that the government sector of the home country increases the quantity of domestic money. Suppose also that the exchange rate and the domestic price are given by the long-run equilibrium Q_0 in Figure (6-a), where the balance of trade is in equilibrium and the expected exchange rate corresponds to the current rate. The increase in the domestic money supply shifts the VV schedule upwards and the XX schedule rightwards. The VV schedule moves upwards since the increase in domestic money makes the domestic currency depreciate at a given level of the domestic price by decreasing the domestic interest rate on the one hand, and by creating an excess demand for foreign assets directly on the other. The XX schedule shifts rightwards since the increase in the domestic money supply stimulates the effective demand for home-produced goods through the wealth effect and thereby makes the domestic price go up at the initial level of the exchange rate. Consequently, equilibrium of the system will move from Q_0 to Q_1 ; at point Q_1 , the domestic currency depreciates and the domestic price goes up, compared to their initial levels.¹

1. Partially differentiating equations (i), (ii) and (4) with respect to $\log M$, we obtain:

$$\left(\frac{d \log e}{d \log M}\right)_S = 1 - (d_1 f_1) / D_S$$

$$\left(\frac{d \log p}{d \log M}\right)_S = 1 - f_1 / D_S$$

$$\left(\frac{d \log i}{d \log M}\right)_S = -k_1 f_k / D_S ,$$

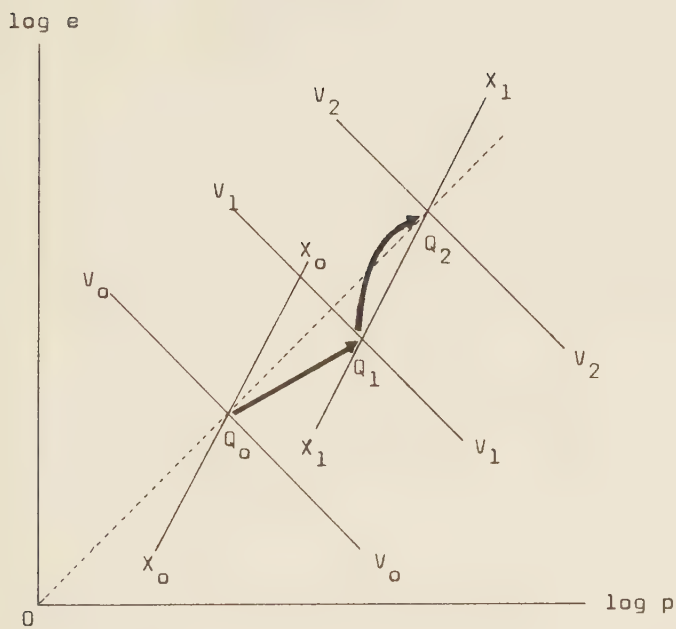
where

$$D_S \equiv d_1 (f_1 + 1) + f_2 k_1 + (r - 1)$$

$\underline{d}$ stands for partial differential.

(Continued)

Figure 6-a



This short-run equilibrium is characterized by two important features. First, both the rate of depreciation of the exchange rate and the rate of increase in the domestic price are smaller than the rate of increase in the domestic money supply. Taking into account the existence of neutrality of money in the long-run equilibrium, the result that the exchange rate depreciates less than the rate of monetary expansion is particularly worth noting. For it suggests that the short-run equilibrium exchange rate does not overshoot the long-run rate as a result of a monetary expansion. A more detailed discussion on this point will be made later in this section. Second, the rate of increase in the domestic price is larger than the rate of depreciation of the exchange rate. This stems from the negative effect of an increase in domestic money on the level of saving. A monetary expansion makes the rate of saving negative by increasing the domestic expenditure more than income and tends to stimulate the effective demand for home-produced goods. Obviously, this increase in the effective demand makes the domestic price go up, which tends to offset the expansionary effect of the increase in the quantity of domestic money by reducing the real stock of wealth. However, the rise in the domestic price is not large enough to reverse the initial expansionary effect resulting from the increase in domestic money. That is, the level of saving remains negative in the short-run. Given the present equilibrium condition of the goods market, this means that the balance of trade should deteriorate as a result of the monetary expansion. The deterioration of the balance of trade will occur in the present model only if the domestic price goes up more than the

Noting that all parameters have positive signs, we can see that the first two derivatives are positive and the third one is negative. It is also readily seen that the rate of depreciation of the exchange rate and the rate of increase in the domestic price are smaller than 1. Finally, the domestic price increases more than the exchange rate depreciates, since

$$\left(\frac{d \log p}{d \log M_S}\right) - \left(\frac{d \log e}{d \log M_S}\right) = d_2 f_1 / D_S > 0 .$$

exchange rate depreciates, so that domestic goods become relatively more expensive than import goods and demand shifts away from domestic to foreign goods through the substitution effect.

The short-run equilibrium position Q_1 was derived under the assumption that the stock of foreign assets held by the private sector and the expected exchange rate remain unchanged. However, these variables also change as a result of the domestic monetary expansion and these changes have repercussions on the short-run equilibrium exchange rate, domestic price and interest rate. In analyzing how the exchange rate and the domestic price change over time, it is convenient to first investigate the adjustment of the expected exchange rate and of the stock of foreign monetary assets to the long-run equilibrium levels.

Figure (6-b) illustrates the adjustment process of the two variables to the long-run equilibrium when there is an increase in domestic money. The E_{OO} and A^*A^* schedules represent the initial loci along which the expected exchange rate is equal to the current rate, and the balance of trade is in equilibrium, respectively; T_0 represents the initial long-run equilibrium position of the expected exchange rate and the stock of foreign assets.

An increase in domestic money shifts the EE schedule upwards. Since monetary expansion makes the current exchange rate depreciate by creating an excess demand for foreign assets, the expected exchange rate should rise at a given level of foreign monetary assets in order for the expected exchange rate to be in equilibrium.¹

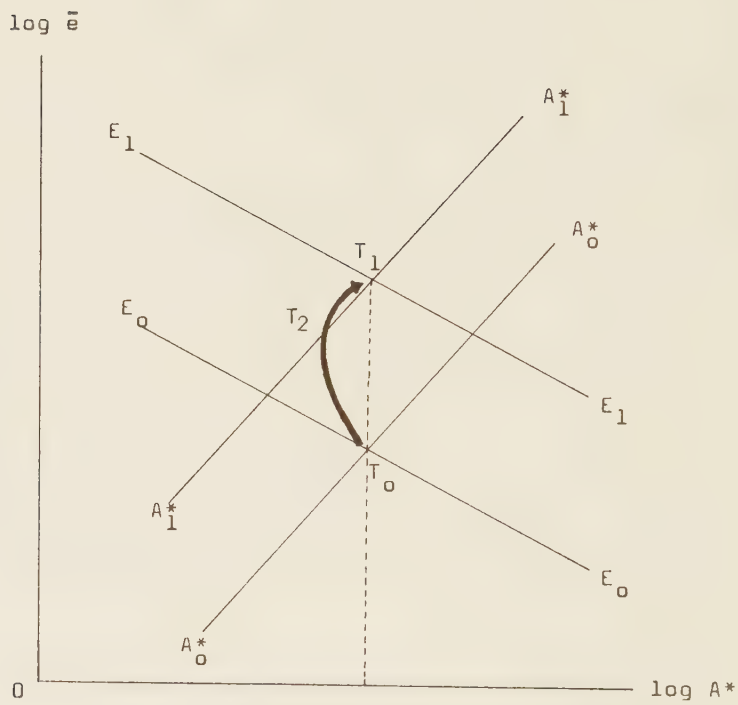
1. Using equation (ix), we find the following relation among $\log \bar{e}$, $\log A^*$ and $\log M$:

$$\log \bar{e} \Big|_{EE} = - (B_2/B_1) \log A^* + \log M.$$

It is readily seen from the above equation that an increase in domestic money shifts the EE schedule upwards at a given stock of foreign monetary assets held by the private sector of the home country.

Note that the coefficient of $\log M$ is 1 because $B_1 = B_3$.

Figure 6-b



On the other hand, the domestic monetary expansion shifts the A^*A^* schedule leftwards, since it makes the domestic price increase more than the exchange rate depreciate by stimulating the effective demand for home-produced goods and results in a balance-of-trade deficit; thus, in order for equilibrium of the balance of trade to be maintained, the stock of foreign assets should decrease at a given level of the expected exchange rate so that effective demand and the domestic price fall to offset the effect of the depreciation of the domestic currency on the balance of trade.¹

Thus, the new EE and A^*A^* schedules are shown, for example, by the E_1E_1 and $A^*A^*_1$ schedules, and the new long-run equilibrium levels of the expected exchange rate and foreign assets will be represented by point T_1 . The adjustment of the expected exchange rate and the stock of foreign monetary assets to the long-run equilibrium point T_1 is illustrated by the arrow T_1T_1 . As already noted in section 4, below the E_1E_1 schedule, the expected exchange rate is increasing, while to the right of the $A^*A^*_1$ schedule the home country has a trade deficit. Thus, at point T_0 , the expected value of the domestic currency is falling and the stock of foreign assets is decreasing. On the dynamic properties given by equations (12) and (13), the path to equilibrium will be clockwise as shown by T_0T_1 . During the adjustment process to equilibrium, the system crosses over the $A^*A^*_1$ schedule at T_2 meaning that the balance of trade position of the home country turns into a surplus and the initial trade deficit is offset. As Figure (6-b) shows, the new long-run equilibrium will be on the vertical line which goes through point T_0 because neutrality of money holds in the

1. The effect of an increase in domestic money on the A^*A^* schedule is derived from equation (xi), namely,

$$\log \bar{e}|_{A^*A^*} = (H_2/H_1) \log A^* + \log M.$$

It is seen from the above equation that an increase in domestic money shifts the A^*A^* schedule leftwards at a given level of the expected exchange rate.

long-run equilibrium; that is, the expected external value of domestic money falls by the same proportion as the increase in the domestic money supply, while the stock of foreign monetary assets will remain unchanged.¹

The adjustment of the exchange rate and the domestic price to long-run equilibrium by changes in the expected exchange rate and the stock of foreign assets is illustrated by the curve Q_1Q_2 in Figure (6-a). At point Q_1 , which is situated below the 45 degree line QQ_0Q_2 , the home country has a balance of trade deficit, making the VV schedule move upwards and the XX schedule leftwards. On the other hand, the depreciation of the current exchange rate in the short-run gradually induces the private sector to revise its expectation on the exchange rate and brings about a rise in the expected exchange rate (namely, a fall in the expected value of the domestic currency), also shifting the VV schedule upwards. The adjustment will continue until the system restores the long-run equilibrium at Q_2 , where the balance of trade is equal to zero and the long-run expected exchange rate is equal to the current rate. Under the particular assumption of the model that government securities have no wealth effect, the domestic price increases and the exchange rate depreciates by the same proportion as the increase in domestic money in the long-run; that is, neutrality of money holds in the long run and Q_2 is situated on the line which goes through 0 and Q_1 . The curve Q_1Q_2 will cross the QQ_2 line, as Figure (6-a) shows. This reflects a change in the balance-of-trade position of the home country from a deficit to a surplus, as mentioned in the

1. The long-run effects of an increase in the domestic money supply on the exchange rate, the domestic price and the stock of foreign assets are obtained by differentiating equations (v), (vi) and (vii) with respect to $\log M$ under the condition $\log e = \log \bar{e}$. They are shown by the following partial derivatives:

$$\left(\frac{d \log e}{d \log M}\right)_L = 1, \quad \left(\frac{d \log P}{d \log M}\right)_L = 1, \quad \left(\frac{d \log A^*}{d \log M}\right)_L = 0,$$

$\underline{d}$ stands for partial differential.

previous analysis of the adjustment of the stock of foreign monetary assets; that is, a balance-of-trade surplus implies that the exchange rate depreciates more than the domestic price rises, and demand shifts away from home-produced goods to import goods through the substitution effect.

This analysis arrives at two interesting results, different from those reached in other work based upon either the portfolio approach or the standard approach.

(1) An increase in the domestic money supply makes the domestic currency depreciate more in the long-run than in the short-run; that is, the short-run equilibrium exchange rate does not overshoot the long-run equilibrium exchange rate.¹ This result stems from three factors which characterize the present model.

First, the expectation about the exchange rate is formed following the adaptive expectation hypothesis; when the observed exchange rate is different from the expected one, the private sector does not believe that the observed exchange rate is permanent and only partly revises what it considers to be a long-run exchange rate. This means that a 10 per cent depreciation (appreciation) of domestic money in the current period does not induce an immediate revision of the expected long-run exchange rate by the same percentage, but only a partial revision of less than 10 per cent. As a result, the depreciation (appreciation) of the domestic currency is followed by an increase in the expected rate of return on domestic (foreign) monetary assets because of a smaller adjustment of the expectation on the exchange rate.

1. The present result is in contrast to the one obtained by H. Genberg and H. Kierzkowski, "Employment and Price Fluctuations under Flexible Exchange Rates," The Graduate Institute of International Studies (May 1975); and P.J.K. Kouri, "The Exchange Rate and the Balance of Payments in the Short-run and in the Long-run: A Monetary Approach," presented at the Stockholm Seminar (August 1975).

Second, it is assumed that the expected rate of change of the exchange rate constitutes part of the yield differential between domestic and foreign monetary assets and is one of the determinants of the investment demands for the two national assets. Consequently, whenever the expected exchange rate diverts from the current exchange rate, the determination of the exchange rate depends partly upon the effect of the expected rate of change in the exchange rate on the investment demands for monetary assets.

The important implication of these two assumptions is that they reduce the short-run impact of a change in the quantity of money (more generally, the short-run impact of a change in the exogenous variables in equation (1)) upon the exchange rate. This can be illustrated as follows. An increase in domestic money tends to make the domestic currency depreciate by creating an excess demand for foreign assets. Under the adaptive expectation hypothesis, however, the expected long-run external value of the domestic currency is higher than its current external value. Given the assumption that the investment demands for domestic and foreign assets depend upon the expected rate of change of the exchange rate, the difference between the expected and the actual exchange rates induces the private sector to increase investment demand for domestic monetary assets because of the expected capital gains. Part of the increase in the domestic money supply is absorbed by an increase in the investment demand for them, and the domestic currency depreciates less. The depreciation of the domestic currency will be smaller, the greater the elasticity of the investment demands for domestic and foreign assets with respect to the expected rate of change in the exchange rate and the smaller the adjustment of the expected exchange rate to the observed exchange rate.

A third factor also important for "undershooting" is that the domestic price constitutes one of the explanatory variables of exchange rate determination through its effect on the transactions demand for domestic monetary assets. As equation (1) shows, a rise (fall) in the domestic price makes the domestic currency appreciate (depreciate) by increasing

(decreasing) the transactions demand for domestic monetary assets, thereby creating an excess demand for (supply of) them. This implies that depreciation of the domestic currency will be smaller, if monetary expansion raises the domestic price by stimulating effective demand for domestic goods.

The importance of these three factors is seen from equation (i). Eliminating other variables except for $\log e$, $\log p$, $\log \bar{e}$ and $\log M$, we obtain

$$(f_1+1)\log e = f_1 \log \bar{e} + (f_2 k_1 + r)\log M - (f_2 k_1 + r - 1)\log p .$$

The above equation indicates that as long as conditions $f_1 \neq 0$ and $\log e \neq \log \bar{e}$ hold and the domestic price raises (as a result of a monetary expansion) proportionately or more than the exchange rate depreciates, the rate of depreciation of the domestic currency will be smaller than the rate of increase in the domestic money supply. For, assuming $\log p = (1+\beta)\log e$ ($\beta \geq 0$) and substituting it into the above equation,

$$(f_2 k_1 + r + f_1 + \bar{U})\log e = f_1 \log \bar{e} + (f_2 k_1 + r)\log M,$$

where

$$\bar{U} = \beta(f_2 k_1 + r - 1) \geq 0 .$$

Obviously,

$$\left(\frac{d \log e}{d \log M} \right) = \frac{(f_2 k_1 + r)}{(f_2 k_1 + r + f_1 + \bar{U})} < 1 .$$

As already seen, the domestic price increases more than the exchange depreciates in the short-run equilibrium, and the assumed change in the domestic price in the above discussion is satisfied in the present model.¹

1. If the expected exchange rate adjusts immediately to the current exchange rate, f_1 will disappear from the above equation. It seems that even in that case, the exchange rate still undershoots as long as $\bar{U}$ is positive, namely, β is positive. This conclusion, however, is not compatible in the present model with the assumption (Continued)

(2) The analysis shows that, contrary to the standard theory, an expansion of domestic money does not create a surplus of the balance of trade in the short-run equilibrium. According to the standard approach, an increase in the supply of domestic money brings about a balance-of-trade surplus by lowering the domestic interest rate and thereby inducing a capital outflow. This conclusion, as already discussed in chapter 1, presupposes the standard external equilibrium condition, in which the portfolio adjustment nature of international capital movements is not fully taken into account. The model developed here is different from the standard model in that capital movements are specified in the framework of portfolio adjustment. A distinction is made between those international asset movements arising from the private sector's desired accumulation of new assets and those arising from a once-and-for-all portfolio adjustment. Equation (13), which represents the flow accumulation of foreign assets reflects the flow decision taken by the private sector and is independent of a once-and-for-all portfolio adjustment; it indicates that the rate of change in the stock of foreign assets is determined by the home country's balance of trade position. On the other hand, international asset movements which are induced by a once-and-for-all portfolio reallocation are regarded as mainly leading to variations of the exchange rate and are assumed to affect the home country's balance-of-trade position indirectly through its effect on the exchange rate.

Within this analytical framework, an increase in domestic money is regarded as inducing a portfolio readjustment by creating an excess demand for foreign assets on the one hand, and as stimulating the domestic expen-

$\log e = \log \bar{e}$, since the partial derivatives of the exchange rate and the domestic price with respect to a change in the money supply in footnote 1 on page 114 show that the exchange rate depreciates and the domestic price goes up by the same proportion as an increase in the domestic money supply when $\log e = \log \bar{e}$, and consequently the partial derivatives do not depend upon f_1 . That is, the exchange rate immediately adjusts to the long-run level and undershooting does not occur.

diture through the wealth effect on the other. Although the excess demand for foreign assets brings about a depreciation of the domestic currency, its substitution effect on the balance of trade is overwhelmed by the wealth effect created by the monetary expansion; the domestic price increases more than the exchange rate depreciates and the balance of trade deteriorates in the short-run equilibrium.

The present analysis shows, however, that the balance of trade turns into a surplus during the adjustment to the long-run equilibrium as the expected exchange rate changes and the stock of foreign monetary assets falls. The expected exchange rate gradually rises as the system approaches long-run equilibrium, which makes the current exchange rate depreciate further compared to its short-run equilibrium level by raising the expected capital gains on foreign monetary assets and thereby inducing an excess demand for them. This depreciation of the domestic currency makes import goods more expensive than home-produced goods, and tends to reverse the initial deterioration of the balance of trade. On the other hand, the initial expansion in the level of expenditure, which was brought about by the increase in domestic money, also tends to decline as the stock of foreign assets decreases and the wealth stock falls. Thus, these two factors combine to turn the home country's balance-of-trade position into a surplus. But, as the system approaches to the long-run equilibrium, the surplus disappears and the balance of trade reaches equilibrium.

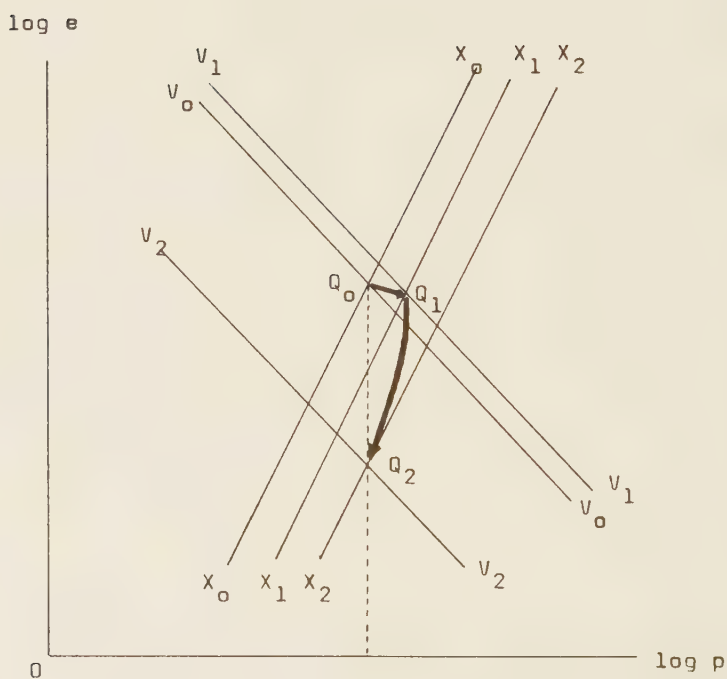
- (b) The effect of an increase in the foreign price on the domestic economy

It is generally argued that, under flexible exchange rates, inflation is not transmitted internationally; in contrast to fixed exchange rates, flexible exchange rates have a strong insulation effect.¹ However, we can show that the insulation effect is not perfect in the short-run under the present model. To illustrate this, suppose that the foreign price rises for some reason. An increase in the foreign price pushes the VV schedule

1. The insulation effect of flexible exchange rates is discussed by

(Continued)

Figure 7-a



upwards and the XX schedule rightwards; the XX schedule moves rightwards since an increase in the foreign price switches demand away from foreign to domestic goods through the substitution effect and raises the domestic price; on the other hand, the VV schedule shifts upwards since the foreign price increase raises the transactions demand for foreign liquid assets and makes the domestic currency depreciate at a given level of the domestic price. Consequently, the short-run equilibrium is given, for example, by point Q_1 in Figure (7-a). One can see that at the short-run equilibrium point Q_1 the domestic price is higher compared to its initial level; the extent to which the domestic price increases depends upon the strength of the substitution effect; the stronger it is, the more will the XX schedule shift rightwards and the larger will be an increase in the domestic price. However, the effect of an increase in the foreign price on the exchange rate is not certain. For, on the one hand, an increase in the foreign price tends to make the domestic currency depreciate by bringing about an excess demand for foreign assets, and on the other hand, it tends to create the opposite effect on the domestic currency by resulting in an increase in the domestic price and thereby inducing an excess demand for domestic assets. Thus, the short-run level of the exchange rate depends upon which schedule shifts more; if the shift of the XX schedule is larger than that of the VV schedule, the domestic currency will appreciate, and vice versa.¹

M. Friedman, "The Case for Flexible Exchange Rates," in M. Friedman, Essays in Positive Economics (Chicago: University of Chicago Press, 1953) pp. 157-203.

1. The short-run effect of an increase in the foreign price on the exchange rate, the domestic price and interest rate is given by the following partial derivatives:

$$\left(\frac{d \log e}{d \log p^*}\right)_S = ((d_1 - d_4)(r-1) - d_4 f_2 k_1) / D_S \approx 0$$

$$\left(\frac{d \log p}{d \log p^*}\right)_S = (d_4(f_1 + 1) + (r-1)) / D_S > 0$$

(Continued)

The dynamic adjustment process to the long-run equilibrium is illustrated in Figure (7-b). Figure (7-b) shows that the A^*A^* schedule shifts rightwards as a result of the increase in the foreign price. For an increase in the foreign price stimulates the demand for domestic goods through the substitution effect and leads to a surplus of the balance of trade. Therefore, in order for equilibrium of the balance of trade to be maintained, the stock of foreign assets should increase so that the effective demand for domestic goods and the domestic price increase on the one hand, and the exchange rate appreciates on the other.¹

The direction in which the EE schedule shifts, however, is not certain because of the two opposite forces mentioned above. If it is assumed that the rise in the foreign price increases the transaction demand for domestic monetary assets more than that for foreign monetary assets, then the EE schedule shifts downwards, moving from the E_0E_0 to the E_1E_1 schedule. For the foreign price increase makes the current exchange rate appreciate, and in order for the expectation on the exchange rate to be in equilibrium, the expected exchange rate should fall (namely, the

$$\left(\frac{d \log i}{d \log p^*} \right)_S = k_1 (d_4 (f_1 + 1) + (r-1)) / D_S > 0 ,$$

where

$$D_S \equiv d_1 (f_1 + 1) + f_2 k_1 + (r-1)$$

$\underline{d}$ stands for partial differential.

It is readily seen from the above partial derivatives that an increase in the foreign price has a positive effect on the domestic price, while its effect on the exchange rate is not certain.

1. This can be proved by the use of equation (xi), which gives us

$$\log \bar{e} \Big|_{A^*A^*} = (H_2/H_1) \log A^* - (H_4/H_1) \log p^*.$$

As (H_4/H_1) is positive, it is seen that an increase in the foreign price shifts the A^*A^* schedule rightwards at a given level of the expected exchange rate.

expected external value of the domestic currency should increase) at a given level of foreign monetary assets. If the increase in the foreign price has the opposite effect on the transaction demands for domestic and foreign monetary assets, the EE schedule will shift upwards.¹

Assuming for the time being that the EE schedule shifts downwards, we will obtain the new long-run equilibrium at point T_1 . The adjustment path to point T_1 is given by the curve T_0T_1 in Figure (7-b). At point T_0 , which is situated above both the E_1E_1 and $A_1^*A_1^*$ schedules, the home country has a trade surplus and the expected exchange rate is declining (namely, the expected value of the domestic currency increases). The system will move from T_0 down to T_1 , where the long-run equilibrium is attained. It should be noted that the line T_0T_1 is parallel to the line a_0a_1 ; that is, the rate of change of the expected exchange rate is equal to the rate of change in the stock of foreign assets, which in turn is equal to the rate of increase in the foreign price.²

Corresponding to these changes in the expected exchange rate and the stock of foreign monetary assets, the current exchange rate appreciates

1. Equation (xi) gives us the following relation among the expected exchange rate, the stock of foreign assets and the foreign price:

$$\log \bar{e} \Big|_{EE} = - (B_2/B_1) \log A^* + (B_4/B_1) \log p^* .$$

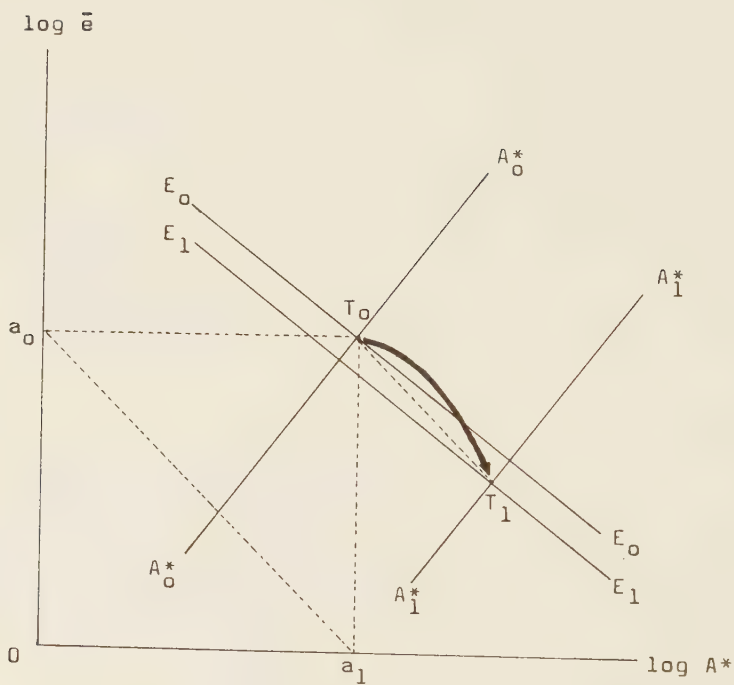
The direction in which the EE schedule shifts depends upon the sign of B_4
 $= (d_1 - d_4)(r-1) - d_4 f_2 k_1 \stackrel{?}{\neq} 0$. If B_4 is negative, the EE schedule will shift downwards, and if B_4 is positive, the EE schedule will shift upwards.

2. The long-run effect of an increase in the foreign price on the exchange rate, the domestic price and the stock of foreign assets are given by

$$\left(\frac{d \log e}{d \log p^*} \right)_L = -1, \quad \left(\frac{d \log p}{d \log p^*} \right)_L = 0, \quad \left(\frac{d \log A^*}{d \log p^*} \right)_L = 1 ,$$

$\underline{d}$ stands for partial differential.

Figure 7-b



and the domestic price declines continuously. This adjustment is illustrated by the curve Q_1Q_2 in Figure (7-a). The long-run equilibrium exchange rate and domestic price will be established at point Q_2 , where the exchange rate depreciates by the same proportion as the foreign price increases while the domestic price remains unchanged. This result suggests that the insulation effect of flexible exchange rates is perfect only in the long-run, but it is not so in the short-run.¹

So far it has been assumed that an increase in the foreign price shifts the EE schedule downwards. What will happen if the EE schedule shifts upwards? The adjustment process of the expected exchange rate and the stock of foreign assets in this case is illustrated in Figure (7-c). Point T_0 is now situated above the $A_1^*A_1^*$ schedule but below the E_1E_1 schedule. Thus, at T_0 the expected exchange rate is rising and the stock of foreign assets is increasing. However, the expectation on the exchange rate is likely to be reversed during the adjustment to the long-run equilibrium T_1 , since the curve T_0T_1 crosses the E_1E_1 schedule at T_2 . Thus, after point T_2 , the expected exchange rate will decline (namely, the expected value of the domestic currency will rise) until the long-run equilibrium is attained.

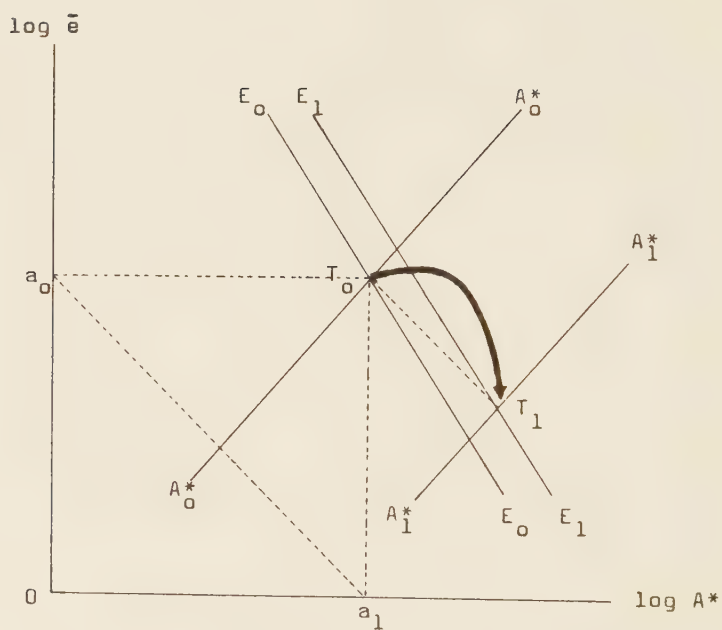
The current exchange rate will show similar movements; initially the exchange rate depreciates, but later it will start to appreciate as the stock of foreign monetary assets increases through a balance-of-trade surplus. On the other hand, the domestic price, which also rises initially, will fall as the exchange rate appreciates. These adjustments will continue until the long-run equilibrium is reached, which is characterized by the same properties as the previous case.

- (c) The effect of a change in the foreign real income on the domestic economy.

What effect will foreign real disturbances have on the exchange rate, the domestic price and interest rate under flexible exchange rates? To

1. The same conclusion is also obtained by H. Genberg and H. Kierzkowski, op. cit.

Figure 7-c



discuss this problem, let us suppose that the real income of the foreign country increases exogenously, which represents a typical example of foreign real disturbances. Obviously, the increase in the foreign real income will stimulate exports from the home country. In the short-run, the increase in exports brings about an increase in the domestic price and an appreciation of the domestic currency. The domestic price goes up since the increase in exports makes the aggregate demand for home-produced goods larger and creates an excess demand for them. On the other hand, the exchange rate appreciates because the increase in the domestic price brings about an excess demand for domestic assets directly by raising the transactions demand for them. Thus, the equilibrium position moves from Q_0 to Q_1 with VV schedule shifting downwards and the XX schedule shifting rightwards as Figure (8-a) shows.¹

At the short-run equilibrium point Q_1 , the home country has a trade surplus, which shifts the XX schedule further rightwards and the VV schedule downwards. On the other hand, the expected value of the domestic currency starts rising as a result of the appreciation of the current exchange rate, which shifts the VV schedule downwards. Thus, the equilibrium position moves from Q_1 to Q_2 with the exchange rate appreciating further and the domestic price declining. The home country reaches the long-run equilibrium at point Q_2 , where the domestic currency appreciates more than the domestic price falls as a result of the increase in the foreign income.² (see overleaf)

1. The short-run effect of an increase in the foreign real income on the exchange rate, the domestic price and interest rate is obtained by differentiating equations (i), (ii), and (4) with respect to the shift parameter R:

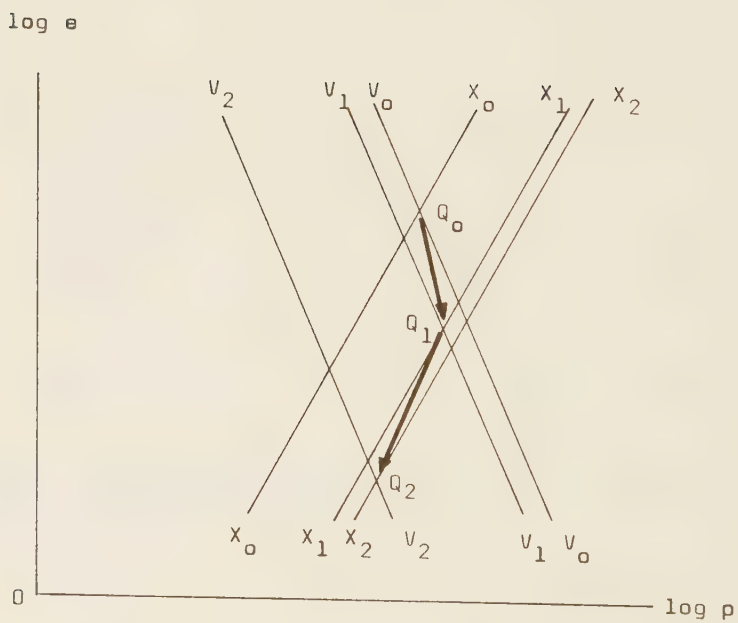
$$\left(\frac{d \log e}{dR}\right)_S = -d_6(f_2 k_1 + r - 1)/D_S < 0$$

$$\left(\frac{d \log p}{dR}\right)_S = d_6(f_1 + 1)/D_S > 0$$

$$\left(\frac{d \log i}{dR}\right)_S = k_1 d_6(f_1 + 1)/D_S > 0, \quad D_S \equiv d_1(f_1 + 1) + f_2 k_1 + (r - 1).$$

(Continued)

Figure 8-a



This adjustment process can alternatively be described in terms of the adjustment of the expected exchange rate and the stock of foreign assets. Figure (8-b) shows that an increase in foreign real income shifts the EE schedule downwards and the A*A* schedule rightwards. The EE schedule moves downwards because the increase in the foreign income brings about a surplus of the balance of trade and leads to an appreciation of the domestic currency; consequently, at a given level of foreign assets, the expected exchange rate should fall in order for the expectation of the exchange rate to be in equilibrium.¹ The A*A* schedule shifts to the right because, in order for the positive effect of the increase in the foreign income on the balance of trade to be offset and equilibrium of the balance of trade to be maintained, the stock of foreign assets should increase at a given level of the expected exchange rate so that the exchange rate appreciates sufficiently to make import goods cheaper than domestic goods.²

The partial derivatives indicate that an increase in the foreign real income brings about an appreciation of the domestic currency and an increase in both the domestic price and interest rate.

2. (ref: page 123) The long-run effect of an increase in the foreign real income on the exchange rate, the domestic price and the stock of foreign monetary assets are given by the following derivatives:

$$\left(\frac{d \log e}{dR}\right)_L = \left(\frac{d \log \bar{e}}{dR}\right)_L = - (u_2 (f_2 k_1 + r - 1) + r) / D_L < 0$$

$$\left(\frac{d \log p}{dR}\right)_L = - u_2 (r - 1) / D_L < 0$$

$$\left(\frac{d \log A^*}{dR}\right)_L = (u_2 (f_2 k_1 + r - 1) + 1) / D_L > 0 ,$$

$$D_L \equiv c_1 (u_2 f_2 k_1 + r) .$$

1. This point is shown by the following relation among $\log \bar{e}$, $\log A^*$ and R ,

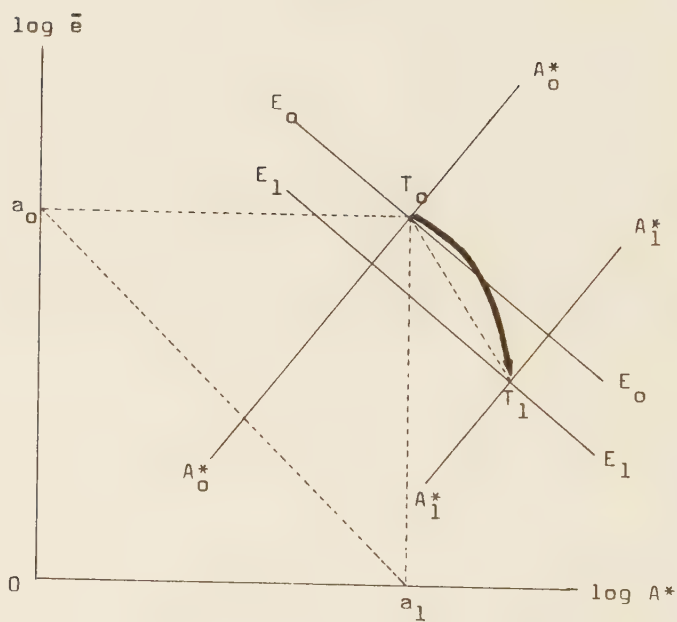
$$\log \bar{e} \Big|_{EE} = - (B_2 / B_1) \log A^* - (B_5 / B_1) R .$$

Thus, an increase in R shifts the EE schedule downwards at a given level of foreign monetary assets.

2. Equation (xi) gives us the following relation among $\log \bar{e}$, $\log A^*$ and R ,

(Continued)

Figure 8-b



In Figure (8-b), point T_0 is situated above both the E_1E_1 and A^*A^* schedules; that is, where the expected exchange rate is falling and the stock of foreign assets increasing. This adjustment will continue until the new equilibrium expected exchange rate and stock of foreign assets are reached at T_1 , where the expected exchange rate is lower and the stock of foreign assets is larger compared to their initial levels. It should be noted that the line T_0T_1 is steeper than the line a_0a_1 ; the expected exchange rate falls more than the stock of foreign monetary assets increases.¹

The analytical results above on the effect of a change in the foreign income contrast to those reached by the standard theory. According to the standard theory, an exogenous change in exports does not affect the real income (namely, price in the case of full employment) nor the balance of trade of the home country if capital is either perfectly immobile or perfectly mobile.² In the case of capital immobility, a change in exports can not affect them because the external equilibrium condition in the standard approach requires the balance of trade to be always equal to zero; thus, any exogenous change in exports leads only to a corresponding adjustment of the exchange rate. On the other hand, if capital is perfectly mobile, an exogenous increase in the home country's exports tends to stimulate its effective demand and raise the domestic interest rate. Given the definition of perfect capital mobility and the flow external equilibrium condition in the standard model, the increase in the domestic interest rate induces an amount of capital inflow to the home country

$$\log \bar{e}|_{A^*A^*} = (H_2/H_1) \log A^* - (H_5/H_1) R .$$

It is readily seen that an increase in R shifts the A^*A^* schedule rightwards at a given level of the expected exchange rate.

1. For this point see footnote 2 on page 135.

2. This, of course, presupposes that the terms of trade effect is zero and the home country is assumed to be a small-country. For this point see chapter 1.

which perfectly offsets the initial trade surplus brought about by an increase in the foreign real income, and consequently reduces the effective demand in the home country to the initial level. In the model elaborated here, however, this standard conclusion does not hold mainly because the balance of trade is not assumed to depend upon the capital account through the flow constraint based upon the flow external equilibrium condition. That is, the balance of trade position is regarded here as a result of the flow commodity equilibrium which is independent of the capital account.

(6) Concluding Remarks

In this chapter, the portfolio approach to exchange-rate determination was integrated into a macro model under the small-country assumption and an analysis was presented of the effects of changes in the domestic money supply, the foreign price and income upon the exchange rate, the domestic price, the domestic interest rate, etc. Three remarks will be useful concerning this analysis.

First, the analysis showed that the short-run equilibrium exchange rate does not necessarily overshoot its long-run equilibrium level when domestic money expands. We have seen that three conditions are essential for this "undershooting". First, the expected rate of change in the exchange rate, which is composed of the expected and the current exchange rates, constitutes one of the determinants of the investment demands for domestic and foreign monetary assets. Second, the expectation of the future exchange rate is such that the expected exchange rate is a positive function of the current exchange rate with an elasticity smaller than 1. Third, the determination of the exchange rate depends partly upon the transactions demands for domestic and foreign monetary assets; therefore, the domestic price constitutes one of the economic determinants of the exchange rate by affecting the transactions demand for domestic monetary assets.

The discussion showed that the second assumption concerning the expectation formation on the exchange rate is particularly important. It

is quite likely that a different type of expectation hypothesis will lead to a different conclusion from the one obtained in this paper. This may be illustrated by the following simple case: the expected exchange rate adjusts to the current rate immediately and the expected rate of change in the exchange rate is equal to zero. As already seen, under this expectation hypothesis, the current exchange rate will depreciate immediately by the same proportion as an increase in domestic money, and the undershooting will not occur.

Secondly, the balance of trade may change sign in approaching the long-run equilibrium when domestic money increases. It was shown that the balance-of-trade position of the home country initially deteriorates as a result of a monetary expansion, but later improves as the expectation on the exchange rate is gradually revised and the stock of foreign monetary assets decreases. Again, this result depends crucially upon the type of expectation formation; if the expectation function does not follow the adaptive expectation model, the above adjustment of the balance of trade may not occur. This can be shown by the use of the expectation hypothesis mentioned above; if the expected exchange rate is always equal to the current exchange rate and the expected rate of change in the exchange rate is zero, a monetary expansion will instantaneously lead to a change in the exchange rate and the domestic price by the same proportion, and the balance of trade will not be affected at all.

Finally, it should be noted that the present analysis was made under the assumption that the approach to the long-run equilibrium is asymptotical. If the system is assumed to approach the long-run equilibrium cyclically, the exchange rate, which constitutes one of the endogenous variables in the model, will also approach its long-run equilibrium level cyclically. This implies that when there is a monetary expansion, the exchange rate will not only undershoot but also overshoot its long-run level as the system approaches the long-run equilibrium. However, it can still be argued that the exchange rate undershoots its long-run equilibrium

level in the short-run equilibrium as a result of a monetary expansion, as long as the short-run equilibrium is defined as the one in which the expected exchange rate and the stock of foreign monetary assets held by the private sector are treated as remaining unchanged.

CHAPTER VI

An Empirical Study of U.S.- Canadian Exchange Rate Determination

In this chapter, I present an empirical study of the assets (or portfolio) approach to the exchange rate. For this purpose, I have constructed a simple econometric model for exchange rate determination based upon the asset approach outlined in the previous two chapters. The econometric model is applied to the determination of the U.S.-Canadian exchange rate during the two recent periods in which the Canadian dollar was allowed to float, namely, the 1950's and 1970's.

The plan of this chapter is as follows. In section 1, I present a brief historical review of the Canadian floating rate during the two periods. In section 2, I construct an econometric model for U.S.-Canadian dollar rate determination. As part of the model, I introduce a reaction function of the Canadian monetary authorities to take into account the possible effects of official intervention on the exchange rate. In the last section, I present the empirical results and comment upon them.

- (1) Historical Review of the Canadian Floating Rate
- (a) The Canadian Floating Rate in the 1950's

Canada was the only industrial country during the early postwar era which adopted a relatively free floating exchange rate for over a decade. The Canadian flexible rate was adopted in October 1950 amid massive inflows of speculative capital into Canada. The movement of this flood of the capital was primarily caused by the expectations among speculators that a strong upward movement in the Canadian dollar, which was induced by a boom in exploitation and development of Canadian resources together with exter-

nal inflationary pressures in early 1950, had led to an undervaluation of the Canadian dollar and that the monetary authorities would find it difficult to avoid revaluation to maintain external equilibrium. During the summer of that year, the monetary authorities responded to capital inflows by selling Canadian dollars, thereby rapidly increasing holdings of official foreign exchange reserves and creating strong inflationary pressures in the Canadian economy.¹

Despite this situation, the Canadian monetary authorities were quite reluctant about the use of revaluation policy; a revaluation would, it was argued, simply lead to massive capital outflows at the expense of Canada and make Canada's balance-of-trade position weaker by inducing an unfavourable adjustment in price and income. Instead, the (temporary) abandonment of a fixed rate was favoured in part to eliminate effectively the inflationary impact of the capital inflows on the domestic credit base and in part to avoid the difficulty of choosing an "appropriate" fixed parity - a difficulty which was amply demonstrated by the unsuccessful results of the devaluation in 1949.² Thus, in order to cope with the situation, the adoption of a floating rate seemed a more effective measure to the Canadian monetary authorities. On September 29, 1950, the Canadian government instructed Canadian Banks to suspend foreign exchange dealings and on October 2 the free market opened.

After the adoption of a floating rate system, the Canadian dollar rose sharply to 105.34 cents (monthly average noon rate), went to parity early in 1952, and remained at a premium between one to four per cent until July 1961.³ The de facto end of the relatively free rate came on June 20,

1. It was said that in ten weeks during the third quarter the foreign exchange reserves went up by over US\$ 500 million, which represented an increase of almost 50 per cent in Canada's official holdings of gold and US dollars. For this point see H.H. Binhammer, "Canada's Foreign Exchange Problems: A Review," Kyklos, No. 4 (1964), pp. 636-652.

2. For a detailed analysis of these points, see H.H. Binhammer, op. cit.

3. In what follows, the Canadian dollar rate is defined as the price of one U.S. dollar in terms of Canadian cents.

1961, when the Finance Minister declared the government's intention of intervening actively in the foreign exchange market to keep the external value of the Canadian dollar lower than the level otherwise determined by the market forces. This shift in the exchange rate policy was aimed at stimulating exports and therefore the whole Canadian economy which had suffered a decline in competitiveness and a sharp increase in the rate of unemployment during the preceding two years.¹ After June 1961, therefore, the Canadian dollar was eventually pushed away from a relatively free-floating rate to a heavily controlled one characterized by large official interventions by the Exchange Fund Account. Consequently, during the following year the Canadian dollar was stabilized at an average of 103.67 cents. Yet, this controlled floating rate was also abandoned on May 2, 1962 when Canada formally returned to a fixed rate with a parity of 108.0 cents.

That fluctuations of the Canadian dollar were quite mild over the entire flexible rate period constituted a remarkable feature of Canada's floating rate. Monthly data on the U.S.-Canadian rate have a mean value of average noon rates of 98.35 cents and a standard deviation was 2.84 cents.² Average noon rates fluctuated between 106.94 cents (June 1951), and 94.77 (October 1954). The difference between high and low quotations was also small.³ Using monthly data, the mean value of the difference was 0.81 cents and its standard deviation 0.23 cents. The highest quotation was 107.31 cents (June 1951) and the lowest one 94.22 cents (August 1957).

1. For this point, see L.B. Yeager, International Monetary Relations: Theory, History, and Policy, 2nd edition (1976) (Harper & Row Publishers New York), chapter 26, "Canada's Fluctuation Exchange Rate," pp.543-565.

2. The calculation covers only the relatively free floating rate period from October 1950 to Dec. 1960. The source of the data is Bank of Canada, Statistical Summary, 1950-1960.

3. The high and low quotations here are different from those of average noon rates. See Bank of Canada, Statistical Summary.

From Table 1 which shows the annual fluctuations of the U.S.-Canadian rate, the stability of the Canadian dollar over the period can be seen.

In retrospect various factors have been pointed out as economic reasons for this stability.¹ Generally speaking, however, this stability

Table 1
Annual Fluctuations of US-Canadian dollar rate

	<u>annual average</u> (cents)	<u>standard deviation</u> (cents)
1950	105.947	0.883
1951	105.273	1.078
1952	97.893	1.455
1953	98.342	0.749
1954	97.330	0.580
1955	98.628	0.886
1956	98.410	1.288
1957	95.885	0.723
1958	97.061	0.748
1959	95.912	0.822
1960	96.978	1.155

Source: The Bank of Canada, Statistical Summary

The exchange rate is the price of one U.S. dollar in terms of Canadian cents. The annual average and its standard deviation were calculated by the use of the monthly data on average noon rates as reported on transactions between banks in the foreign exchange market measured at the end of each month.

was mainly attributed to the free market forces of the demand and supply of foreign exchange and, in particular, to the quick responses of equili-

1. For example, see A.F.W. Plumptre, "Exchange Rate Policy: Experience with Canada's Floating Rate," Princeton Essays in International Finance, No. 81 (June 1970).

brating short-term capital movements to changes in the exchange rate.¹ For example, R.R. Rhomberg's econometric model suggests that a depreciation of the Canadian dollar by 1% induced a short-term capital inflow of about US\$ 24 million during a quarter. Compared to equilibrating short-term capital movements, official interventions by the monetary authorities are generally regarded as having played a less important role in determining the value of the Canadian dollar; average monthly changes in the international reserves held by the Exchange Fund Account were quite small compared to the size of the total monthly balance-of-payments credits or debits on the current account; it has also been observed that, "the Fund was usually acquiring gold and U.S. dollars during months when the Canadian dollar was generally rising and drawing down its reserves during months when the Canadian dollar was generally falling."²

The Canadian experience provides an interesting opportunity for empirical study of controversial problems associated with flexible exchange rates such as the stability of speculation in the foreign exchange market and the effect of exchange risks on international trade and investment. Although the Canadian experience does not necessarily provide general grounds for a strong case in favour of flexible exchange rates, the following two points are worth noting.

1. For example, see R.R. Rhomberg, "Canada's Foreign Exchange Market," I.F.M. Staff Papers, Vol. VII, No. 3 (April 1960), pp. 439-456.

2. For a detailed discussion of this point, see L.B. Yeager, op. cit. Some economists, however, emphasize the importance of the role of the official intervention in stabilizing short-run fluctuations in the external value of the Canadian dollar. For example, J. Pippenger argues, using the autocorrelation and spectral analysis, that the Exchange Fund played an important role in stabilizing the short-run fluctuations in the exchange rate during the floating rate period, although it did not attempt to resist its long-run movements. See J. Pippenger, "The Canadian Experience with Flexible Exchange Rates," American Economic Review Proceedings, 58 (May 1967), pp. 545-560.

First, in the Canadian case, speculation did not necessarily have the strong destabilizing effect on the exchange rate about which advocates of fixed exchange rates often worry. It was observed that short-term capital movements, which may generally be considered to contain a significant speculative element, "tended to resist exchange rate movements" and "to lessen the deviation of the exchange rate from its longer-run average"; short-term capital outflows from Canada correlated negatively with quarterly average exchange rates, each expressed as a percentage of the preceding quarterly average.¹ In addition, it was also observed that despite a substantial seasonal pattern in Canadian trade, exchange rate changes showed no statistically meaningful seasonal fluctuations; moreover, day-to-day rate changes were not serially correlated in the way one would expect if speculators had been riding or reinforcing trends.² This suggests, it is argued, that speculators tended to raise the Canadian dollar when it was falling and to restrain it when it was rising.

Second, risks associated with exchange rate fluctuations did not seem to impede Canada's international trade and capital movements. Canadian exports plus imports after 1950 were much larger than those before 1950. As a percentage of the total world trade, Canada's foreign trade averaged 5.53 per cent from 1947 to 1950 and 5.63 per cent during the decade from 1951 to 1960. Long-term capital movements averaged annually half a billion dollars during the four years 1951-1954 and 800 million during the following six-year period 1955-1960. Given the fact that annual long-term capital flows were small for the four years 1946-1949, the figures indicate a large increase in long-term capital inflows to Canada. In addition, the fact that during the entire flexible exchange rate period Canada received larger amounts of long-term capital than any other country also suggests

1. For this point, see L.B. Yeager, op. cit.

2. See, for example, W. Poole, "The Stability of the Canadian Flexible Exchange Rate, 1952-1962," Canadian Journal of Economic and Political Science, Vol. 33 (May 1967), pp. 205.

that exchange risks had a minor effect on capital flows into Canada.¹

(b) The Canadian Floating Rate in the 1970's

The fixed rate formally adopted in 1962 at the parity of 108.0 cents was again abandoned in May 1970. In the first and the second quarters of that year, Canada's current account, which had recorded a deficit of about US\$ 0.9 billion in the previous year, showed a strong improvement: the deficit of the current account went down from about US\$ 160 million in the last quarter of 1969 to US\$ 7 million in the first quarter of 1970 and turned into a surplus of US\$ 100 million in the second quarter.² This improvement on the current account immediately created the expectation of a likely appreciation of the Canadian dollar and induced the movement of a flood of capital into Canada. The Canadian dollar appreciated rapidly reaching to its upper intervention point, and the increase in Canada's net official foreign assets amounted to US\$ 0.9 billion in the first five months of 1970. Soon the Canadian monetary authorities found that they could no longer handle the situation by continued intervention in the foreign exchange market. The increase in net official foreign reserves had created inflationary pressure in the Canadian economy due to the rapid expansion of the foreign source component of the monetary base.

The policy measure finally chosen by the monetary authorities was the same as the one taken twenty years previously: to float the Canadian dollar. On May 31, 1970, Canada returned to a floating rate system and left the determination of the external value of its currency to the market forces.

1. For those figures, see E. Sohmen, Flexible Exchange Rates revised edition, (Chicago): (University of Chicago Press, 1969), Chapter 7, section 8, pp. 224-239.

2. Canada's current account changed to a surplus of US\$ 1 billion in 1970 from a deficit of about US\$ 0.9 billion in 1969. The surplus on the current account occurred for the first time since 1952. See Bank of Canada Review.

In the first month of floating, the Canadian dollar appreciated, moving from 108.0 to 103.84 cents (average noon rate). Since then and for the period up to December 1976, it has fluctuated smoothly around the level of 99.7 cents (annual average of noon rates). As Table 2 shows, the

Table 2
Annual Fluctuations of U.S.-Canadian dollar rate

	<u>annual average</u> (cents)	<u>standard deviation</u> (cents)
1970	102.135	0.517
1971	100.813	0.574
1972	99.068	0.881
1973	100.008	0.315
1974	97.803	0.916
1975	101.716	1.285
1976	98.603	1.364

Source: Bank of Canada Review

The exchange rate is the price of one U.S. dollar in terms of Canadian cents. The annual average and its standard deviation were calculated by the use of the monthly data of average noon rates as reported on transactions between banks in the foreign exchange market. Note that the figure for 1970 represents the six month average from July to December.

fluctuations of the Canadian dollar during this period as in the 1950's were quite limited and smooth despite several significant developments in the international economy such as the devaluation of the U.S. dollar, the introduction of wider flexibility of exchange rates by the major industrialized countries and the petroleum crisis in 1973. Taking monthly data of average noon rates, we find that the highest quotation was 96.21 cents (May 1974) and the lowest one was 103-84 cents (June 1970).¹ We also find during the period from July 1970 to December 1976 that the largest change

1. See Bank of Canada Review, July 1970 - December 1976.

in the exchange rate from the preceding month was 3.30 cents (from November to December 1976); the monthly change in the exchange rate was smaller than 1 cent in 67 out of 78 months, and smaller than 0.6 cents in 49 out of 78 months; and the mean value of the monthly change in the spot rate was 0.56 cents (in absolute value).

Again it is interesting to ask what factors brought about such stability of the Canadian dollar during floating. Although a detailed discussion on this question is beyond the scope of this paper, it is not irrelevant to point out the importance of official intervention by the Canadian monetary authorities. From the first renewal of floating in 1970 the Canadian monetary authorities made it clear that they would resist what they consider undue oscillations of the Canadian dollar. The effect of this intention of the monetary authorities is quite well shown in the global movements of the exchange rate and in the quantity of foreign reserves held by them. For example, during the period from June 1970 to June 1972, the Canadian dollar appreciated by about 5.7% going up from 103.84 to 97.94 cents, while the official holdings of gold and U.S.dollars increased by about 47%, rising from US\$ 3.65 to 5.38 billion; during the period from August 1974 to August 1975, however, the Canadian dollar depreciated by about 5.7%, falling from 97.98 to 103.53 cents, while the official holdings of gold and U.S. dollars decreased by about 20%, going down from US\$ 4.93 to 3.95 billion.¹ Moreover, if we trace the relation between monthly changes in the exchange rate and those in the official holdings of gold and U.S. dollars, we can find a rather high negative correlation between them.² In other words, the Canadian dollar in the first

1. For those figures, see Bank of Canada Review, *op. cit.* Note the exchange rate mentioned here is monthly average noon rate.

2. If we regress the change in the official holdings of gold and U.S. dollars on the change in the exchange rate using monthly data from July 1971 to June 1976, we obtain the following result:

$$DR_t = -135.7 De_t + 44 S_t^1 + 74 S_t^2 - 92 S_t^3 - 19 S_t^4 - 3 S_t^5 - 21 S_t^6$$

(6.3) (1.0) (1.7) (2.1) (.4) (.1) (.5)

(Continued)

half of the 1970's was a controlled rather than a freely floating currency.

(2) Econometric Model of the U.S.-Canadian Exchange-Rate Determination

The econometric model applied to U.S.-Canadian dollar rate determination is based upon the asset equilibrium condition presented in chapter 4. The model is kept as simple as possible by making the following assumptions.

(a) All variables pertaining to the U.S.- -- foreign country in the present empirical study - are considered exogenous. In other words, Canada is treated as a small country in the sense that she is assumed to behave as a price taker.

(b) To avoid complexities, a simple type of disaggregation approach is used: the Canadian economy is disaggregated into only two sectors, namely, the government and the private sectors. The government section consists of the Bank of Canada, the Treasury Department and the Exchange Fund Account. The private sector is composed of Chartered Banks and the non-bank private sector. The non-bank private sector includes those foreign residents who hold Canadian monetary assets.¹

$$+ 69 S_7 - 20 S_8 - 17 S_9 + .6 S_{10} - 10 S_{11} + 62 S_{12} ,$$

(1.5) (.5) (.4) (.01) (.2) (1.4)

$$R^2 = 0.55 \quad D.W. = 1.63 \quad s = 97 \quad d.o.f. = 47$$

DR_t : change in the official holdings of gold and U.S. dollars (in millions of U.S. dollars) at period t

De_t : change in the exchange rate (average noon rate in Canadian cents) at period t

S_j (j = 1 -- 12) : seasonal intercepts.

(Figures in parenthesis stand for t-statistics.)

The estimation result suggests that a one cent appreciation of the Canadian dollar induces the monetary authorities to purchase about 130 million U.S. dollars per month, a sum roughly equal to 3.5 per cent of the total Canadian stock of the official gold and U.S. dollars in June 1970.

1. When an explicit distinction is necessary between the Canadian and foreign residents, attention will be drawn (Continued)

Noting that under this simple type of disaggregation, debts and assets among the Canadian economic units are regarded as offsetting each other, we can assume that Canadian assets are composed of only two sorts of monetary assets: high powered money and government securities. Under the asset approach to the exchange rate this implies that exchange rate determination is specified in terms of portfolio equilibrium between those Canadian monetary assets defined above and U.S. dollar assets held by the private sector.¹ However, in order to focus the empirical work on the role of money in exchange rate determination, I use Canadian dollars held by the private sector as a proxy for Canadian monetary assets.

(c) In the asset approach domestic and foreign interest rates are important explanatory variables of the exchange rate. In the model, the introduction of the Canadian interest rate as an explanatory variable might be considered troublesome because of the possibility of multi-collinearity brought about by the presence of the stock of Canadian dollars in the model, the variable which is regarded theoretically as a major determinant of the domestic interest rate. In an empirical test, however, rather low correlation was observed between the stock of monetary base and the short-term interest rate in Canada. Thus, the Canadian interest rate will be treated as an independent explanatory variable.²

by the use of expressions such as the Canadian private sector or the foreign private sector.

1. It should be emphasized that U.S. dollars or U.S. dollar assets mentioned here refer only to those held by the private sector defined above. Since foreign residents included in the private sector defined above are only those who hold Canadian monetary assets, the U.S. dollar balances used in the model constitute only part of total U.S. dollars issued by the U.S. monetary authorities. This implies that the present study is mainly concerned with the effect on the Canadian dollar of portfolio choice between Canadian and U.S. dollars made by the private sector defined above, not by the private sector in a broader sense which includes all foreign residents.

2. The Canadian interest rate represented by the three-month treasury bill rate seems to depend mainly upon the stock of treasury bills in Canada and the covered U.S. three month treasury bill rate. To illustrate the point, suppose the Canadian three month treasury rate is determined by:

(Continued)

Given these assumptions, we have the following stochastic equation of exchange rate determination in the first difference form:

$$De_t = k_1 DM_t + k_2 DM_t^* + k_3 D(i^*-i)_t + k_4 D\hat{e}_t + k_5 S_1 + k_6 S_2 + k_7 S_3 + k_8 S_4 + u_{1t} \quad (1)$$

$$i_t = g_1 \left(\frac{B}{A}\right)_t + g_2 \left(\frac{Y}{A}\right)_t + g_3 (i^*+v)_t + \left(\begin{smallmatrix} \text{seasonal} \\ \text{intercepts} \end{smallmatrix}\right) + u_t$$

$$g_1 > 0, \quad g_2 > 0, \quad g_3 > 0,$$

where

i_t : Canadian three-month treasury bill rate

i_t^* : U.S. three-month treasury bill rate

v_t : forward premium

B_t : stock of Canadian treasury bills held by the private sector

A_t : sum of monetary base and treasury bills in Canada

$$A = M + B$$

Y_t : nominal income of Canada

u_t : stochastic disturbance term,

The equation represents the portfolio equilibrium between Canadian money and treasury bills, which is specified in terms of the equilibrium condition of Canadian treasury bills. The specification is based upon J. Tobin, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit and Banking, Vol. 1, 1969, pp. 15-29. The sign of parameter of (Y/A) is expected to be positive because of the assumption that the private sector tries to meet an increase in demand for money due to an increase in income by reducing its demand for treasury bills. The covered U.S. interest rate is introduced in order to capture a possible effect of covered interest arbitrage on the determination of the Canadian interest rate. Estimating the equation using quarterly data from the First Quarter of 1953 to the Last Quarter of 1960, we obtain the following result:

$$i_t = 5.47 \left(\frac{B}{A}\right)_t - 0.32 \left(\frac{Y}{A}\right)_t + 0.63 (i^*+v)_t - 0.18 S_1 - 0.42 S_2 - 0.32 S_3 - 0.17 S_4$$

$$(3.2) \quad (0.3) \quad (9.5) \quad (.07) \quad (.02) \quad (.10) \quad (.06)$$

$$R^2 = 0.89 \quad D.W. = 1.34 \quad s = 0.46 \quad d.o.f. = 24$$

Figures in parenthesis stand for t-statistics.

The data used for the estimation are from Bank of Canada, Statistical Summary, 1953-1960.

$$k_1 > 0, k_2 < 0, k_3 > 0, k_4 > 0,$$

where

- e_t : U.S.-Canadian rate: price of one U.S. dollar in terms of Canadian cents at period t
- M_t : stock of Canadian dollars, which is represented by monetary base in Canada at period t
- M_t^* : stock of U.S. dollars held by the private sector at period t
- i_t and i_t^* : Canadian and U.S. interest rates at period t , respectively
- $\hat{e}_t$: future spot rate which is expected at period t
- S_j ($j = 1 - 4$) : seasonal intercepts for quarterly estimation
- u_{1t} : stochastic disturbance term
- $\underline{\quad}$ stands for the first difference of a variable.

Equation (1) is a reduced form equation of exchange rate determination derived from the portfolio equilibrium between Canadian and U.S. dollar assets held by the private sector. The signs of the parameters are based upon the analysis in chapter 4. Several modifications are added to the original version of the reduced form equation presented there. First, the same parameter is imposed on the Canadian and U.S. interest rates to avoid a bias which may stem from a high correlation between them. Second, the relative price between Canada and the U.S., which is regarded as an important determinant of the exchange rate in the long-run, is excluded from the equation since it turned out in testing that the parameter either had the wrong sign or was not statistically different from zero when estimated together with other variables in equation (1). Third, the risk variable is dropped from the equation because of the difficulty in finding a suitable proxy for it.

The specification of equation (1) will not be complete unless the expectation variable which constitutes one of the explanatory variables in it is specified. Clearly, the best way to choose variables for expectations about the future spot rate would be to construct a theoretical model of expectation formation but this is beyond the scope of this paper.¹ Instead, I base the choice of the determinants of the expectation about the U.S.-Canadian dollar rate on some observed facts: in the case of the first floating rate I choose the flow of long-term capital to Canada as the major determinant of expectation formation about the future U.S.-Canadian dollar rate, while in the case of the second floating rate I regard the U.S. balance-of-trade position as the major determinant.

The introduction of the long-term capital flow to Canada as an explanatory variable of expectation formation is based on the widely observed fact that during the 1950's the Canadian balance-of-payments position depended heavily upon the inflow of long-term capital to maintain equilibrium. It is assumed that the private sector expects the Canadian dollar to depreciate in future periods when the long-term capital inflow decreases, and vice versa. Under this assumption, the expectation function in the first floating rate period will be specified as follows:²

1. Several empirical attempts were made to explain the economic determinants of expectations under the Canadian floating rate in the 1950's, most of which are concerned with those in the forward exchange market. For example, see H.R. Stoll, "An Empirical Study of the Forward Exchange Market Under Fixed and Flexible Exchange Rate System," Canadian Journal of Economics, I, No. 1 (February, 1968), pp. 56-64; J. Kesselman, "The Role of Speculation in Forward-Rate Determination: The Canadian Flexible Dollar 1953-1960," Canadian Journal of Economics, IV, No. 3 (August, 1971), pp. 279-298.

2. A possible criticism of the present specification of the expectation function is that the estimated parameter of the long-term capital flow to Canada does not solely affect the spot rate through expectations of the future spot rate but also directly by changing the Canadian balance-of-payments position. However, this criticism overlooks the important theoretical point in the standard approach that the spot rate is determined by the overall balance-of-payments position of a country, not by one item which constitutes part of the payments position. Therefore, any correlation between the exchange rate and the long-term capital (Continued)

$$D\hat{e}_t = c_1 DK_t \quad (2-a)$$

$$c_1 < 0$$

where

K_t : quarterly figure of the net long-term capital inflow to Canada, which consists of direct and portfolio investment

D stands for the first difference of a variable.

As for the expectation function in the second floating rate, I regard the U.S. balance-of-trade position as an important determinant of the expectations on the future external value of the Canadian dollar, taking into account the private sector's tendency in the first part of the 1970's to attribute great importance to the trade balance in predicting the strength of the U.S. dollar. I assume that the private sector expects the Canadian dollar to appreciate (depreciate) in the future when a deterioration (improvement) of the U.S. balance of trade is reported. Thus, under this assumption, we can specify the expectation function during the second floating rate period as follows:

$$D\hat{e}_t = c_2 DBT_{t-1}^* \quad (2-b)$$

$$c_2 > 0$$

where

BT_{t-1}^* : lagged U.S. quarterly balance-of-trade position

D stands for the first difference of a variable.

In addition to equation (1), I introduce a reaction function which is concerned with interventions in the foreign exchange market by the Canadian monetary authorities. As mentioned in section 1, one of the particular features of the Canadian floating rate is that fluctuations in the Canadian flow which might be found by the estimation of the model could be explained as the effect of the long-term capital flow on the spot rate through expectations.

dollar were quite mild. It was noted that in the case of the first floating rate (and perhaps partly in the second floating rate) this stability is attributed mainly to the free market forces, in particular to equilibrating short-term capital movements. However, in the model I put more emphasis on the importance of official intervention for the stability of the external value of the Canadian dollar,¹ and introduce an official intervention function to avoid a bias which might arise from the neglect of the effect of official interventions on the exchange rate.

In specifying this function, I assume that the official intervention policy is affected by two sorts of policy considerations: internal and external. The Canadian monetary authorities often made it clear that they would resist what they consider to be undue oscillations of the external value of the Canadian dollar. This external consideration may be translated into the following intervention behaviour: the monetary authorities purchase foreign exchanges when the Canadian dollar is appreciating, and sell them when the Canadian dollar is depreciating.² Thus, we expect a negative correlation between a change in official reserve holdings and a change in the external value of the Canadian dollar (given the definition of the exchange rate in this paper) if this simple behavioural hypothesis holds.

Internal policy considerations such as price stability, control of the size of liquidity, etc., will also be regarded as important economic factors which influence official intervention in the foreign exchange market. For, official intervention inevitably affects the total stock of the monetary base in Canada and has a strong impact on domestic price and

1. This assumption is more justifiable in the second floating rate case, where the official intervention seems to play a more important role in stabilizing (in particular, in the short-run) fluctuations of the Canadian dollar. See section (1).

2. Another way to formulate the intervention policy will be to assume that the monetary authorities have a target level of the exchange rate and intervene in the foreign exchange market when the actual rate deviates from that level. One of the difficulties associated with this approach is that it is rather difficult to identify the target level of the exchange rate.

the amount of liquidity. This implies that some economic variables need to be introduced in the reaction function to capture the effect of these internal policy considerations on official intervention. Although various internal policy objectives may be considered for this purpose, I assume that the stabilization of domestic price constitutes the most important internal objective affecting official intervention.¹ More precisely, it will be assumed that a rise in the domestic price level in the current period, other things being equal, leads the Canadian monetary authorities to reduce purchases of foreign exchange and thereby to avoid an increase in the monetary base through its foreign source component.

Under these assumptions, the official intervention function will be specified as

$$DR_t = h_1 De_t + h_2 Dp_t + h_3 S_1 + h_4 S_2 + h_5 S_3 + h_6 S_4 + u_{2t}$$

$$h_1 < 0, \quad h_2 < 0, \quad (2)$$

where

R_t : Canadian official holdings of gold and U.S. dollars
at period t

p_t : domestic price of Canada at period t

Δ stands for the first difference of a variable.

1. Another variable might be the change in real income. It turned out, however, that the effect of that variable on official intervention was not statistically significant. (In estimating the effect of the variable, I assumed that an increase in real income induces the Canadian monetary authorities to increase its purchases of foreign exchanges to meet a possible rise in transaction demand for money as long as other things are equal.) The importance of price stability as an internal policy target is pointed out by some works such as G.L. Reuber, "The Objectives of Canadian Monetary Policy, 1949-61: Empirical "Trade-Offs" and the Reaction Function of the Authorities," Journal Political Economy, Vol. LXXII, No.2 (April 1964); T.J. Courchene and A.K. Kelly, "Money Supply and Money Demand: An Econometric Analysis for Canada," Journal of Money, Credit and Banking, Vol. III, No. 2 (May 1971).

To complete the model, we need to add one identity which defines the composition of the monetary base. The identity is given by the following first difference form:

$$DM_t = DR_t + DN_t \quad , \quad (3)$$

where

N_t : stock of the domestic source component of the monetary base

$\underline{D}$ stands for the first difference of a variable.

Equation (3) shows that the monetary base is composed of two components: the foreign and the domestic components. In the model, the former is determined by the intervention policy of the Canadian monetary authorities, while the latter is treated as an exogenous variable.

Thus, the basic form of our econometric model consists of two stochastic equations and one identity. Because of two different specifications of the expectation variable, we have two econometric models to estimate: Model (I) which is applied to the first floating rate period and Model (II) which is applied to the second.

Before presenting the final form of the two models, I add one dummy variable to Model (II) to capture the impact of the devaluation of the U.S. dollar in January 1973 on the private sector's expectation of the future U.S.-Canadian rate. I assume that, if the devaluation brought about optimistic expectations among economic units concerning the future external value of the U.S. dollar, the sign of the coefficient is positive; conversely, if it led to doubts about the future strength of the U.S. dollar, the sign is negative. Thus, substituting (2) and (3) into (1), we specify Model (I) and (II) as follows:

Model (I)

$$De_t = f_1 (DR_t + DN_t) + f_2 DM^* + f_3 Dz_t + f_4 DK_t \\ + f_5 S_1 + f_6 S_2 + f_7 S_3 + f_8 S_4 + u_{1t} \quad (4)$$

$$DR_t = h_1 De_t + h_2 Dp_t \\ + h_3 S_1 + h_4 S_2 + h_5 S_3 + h_6 S_4 + u_{2t} \quad ; \quad (5)$$

Model (II)

$$\begin{aligned} De_t = & q_1 (DR_t + DN_t) + q_2 DM_t^* + q_3 Dz_t + q_4 DBT_{t-1}^* + q_5 \underline{DUM} \\ & + q_6 S_1 + q_7 S_2 + q_8 S_3 + q_9 S_4 + v_{1t} \end{aligned} \quad (6)$$

$$\begin{aligned} DR_t = & h_1 De_t + h_2 Dp_t \\ & + h_3 S_1 + h_4 S_2 + h_5 S_3 + h_6 S_4 + v_{2t} , \end{aligned} \quad (7)$$

where

$$DZ_t = D(i^*-i)_t$$

DUM : dummy variable for 1973 first quarter

expected sign of parameters:

$$f_1 = k_1 > 0, \quad f_2 = k_2 < 0, \quad f_3 = k_3 > 0, \quad f_4 = k_4 c_1 < 0$$

$$q_1 = k_1 > 0, \quad q_2 = k_2 < 0, \quad q_3 = k_3 > 0, \quad q_4 = k_4 c_2 > 0, \quad q_5 \approx 0$$

$$h_1 < 0, \quad h_2 < 0 ,$$

endogenous variables : De_t and DR_t

exogenous variables :

Model (I) : $DN_t, DM_t^*, Dz_t, DK_t, Dp_t$ and S_j ($j=1-4$)

Model (II) : $DN_t, DM_t^*, Dz_t, DBT_{t-1}^*, Dp_t, \underline{DUM}$ and S_j .

(3) Empirical Results

(a) Empirical Results in the First Floating Rate Case

Model (I) was estimated by the two stage least-squares estimation method, using quarterly data from 1953 to 1960.¹ 1953 was chosen as the first sample year because data for the Canadian private sector's holdings of U.S. dollars are not available for that period. On the other hand,

1. Time Series Processor TSP was used for data transformation and estimation and estimation of the model.

1960 was chosen as the last sample year since after that period official interventions took place in a large scale and pushed the Canadian floating rate system away from a relatively free rate towards a controlled one.¹

The data series which were used for the estimated are as follows:²

- e_t : U.S.-Canadian rate; average noon rate as reported on transactions between banks in the foreign exchange market (in Canadian cents)
- R_t : Canadian official holdings of gold and U.S. dollars (in millions of Canadian dollars) held by the Exchange Fund Account and the Bank of Canada
- i_t : Canadian three-month treasury bill rate (weighted average of Thursday tender rates)
- i_t^* : U.S. three-month treasury bill rate (weighted average of Monday tender rates)
- P_t : Canadian consumer price index (1949 = 100)
- K_t : net long-term capital inflows to Canada, which are composed of direct and long-term portfolio investment (in millions of Canadian dollars)
- N_t : stock of domestic source component of monetary base which is calculated by deducting the foreign source component (adjusted to changes in the exchange rate) from monetary base (Note: monetary base is defined as the sum of notes in circulation and Canadian dollar deposits at the Bank of Canada held by Chartered Banks and "others" in the balance sheet of the Bank of Canada)
- M_t^* : the Canadian private sector's holdings of U.S. dollar assets which are calculated from quarterly figures on Canadian (including the Canadian government) holdings of U.S. dollars as reported by the U.S. (in millions of U.S. dollars)

1. Although the de facto end of a relatively free floating rate was the second quarter of 1961, the first quarter of the year was omitted because speculative capital inflows occurred causing the monetary authorities to respond with a heavy intervention.

2. The data series for the estimation were collected from the Bank of Canada, Statistical Summary except for those on the Canadian holdings of U.S. dollars as reported by U.S., which were collected from I.M.F., International Financial Statistics. All data were measured at the end of each quarterly period, because the data series of the Canadian holdings of U.S. dollars as reported by the U.S. were available only quarterly.

Equations (8) and (9) are the two stage least-squares estimate of Model (I):

$$\begin{aligned} De_t = & .0156 (DR_t + DN_t) + .00072 DM^* + .0309 Dz_t - .0103 DK_t \\ & (3.16) \quad (0.39) \quad (0.09) \quad (4.30) \\ & + 1.94 S_1 - 1.11 S_2 - 1.00 S_3 - .885 S_4 \quad (8) \\ & (3.33) \quad (1.94) \quad (2.35) \quad (1.81) \\ D.W. = & 1.62 \quad s = .97 \quad d.o.f. = 22 \end{aligned}$$

$$\begin{aligned} DR_t = & - 33.8 De_t - 1.75 Dp_t \\ & (6.43) \quad (0.19) \\ & - 1.64 S_1 + 26.6 S_2 - 9.98 S_3 - 3.95 S_4 \quad (9) \\ & (0.16) \quad (2.24) \quad (0.76) \quad (0.39) \\ D.W. = & 1.78 \quad s = 26.5 \quad d.o.f. = 24 \end{aligned}$$

(Note that figures in parenthesis in what follows stand for t-statistics.)

Figures (1) and (2) provide a graphical presentation of the fit of the two estimated equations.

Among the estimated parameters, we notice that the parameter of the Canadian money stock has the expected sign and is statistically different from zero at the 99 per cent level of confidence.¹ The parameter suggests that a \$ 100 million increase in the Canadian monetary base induced a depreciation of the Canadian dollar by about 1.6 cents per quarter. This is equal to about 0.39 in terms of elasticity.² It is rather difficult to compare this result with those obtained by other researchers mainly because of differences in specification. It is interesting, however, that

1. In what follows, the word "statistically significant" is assumed to mean that a parameter is significantly different from zero.

2. Elasticity in what follows is defined as average elasticity which is calculated by using the sample mean values of two variables.

Figure (1)

Equation (8): U.S.-Canadian Exchange Rate (1953-60)

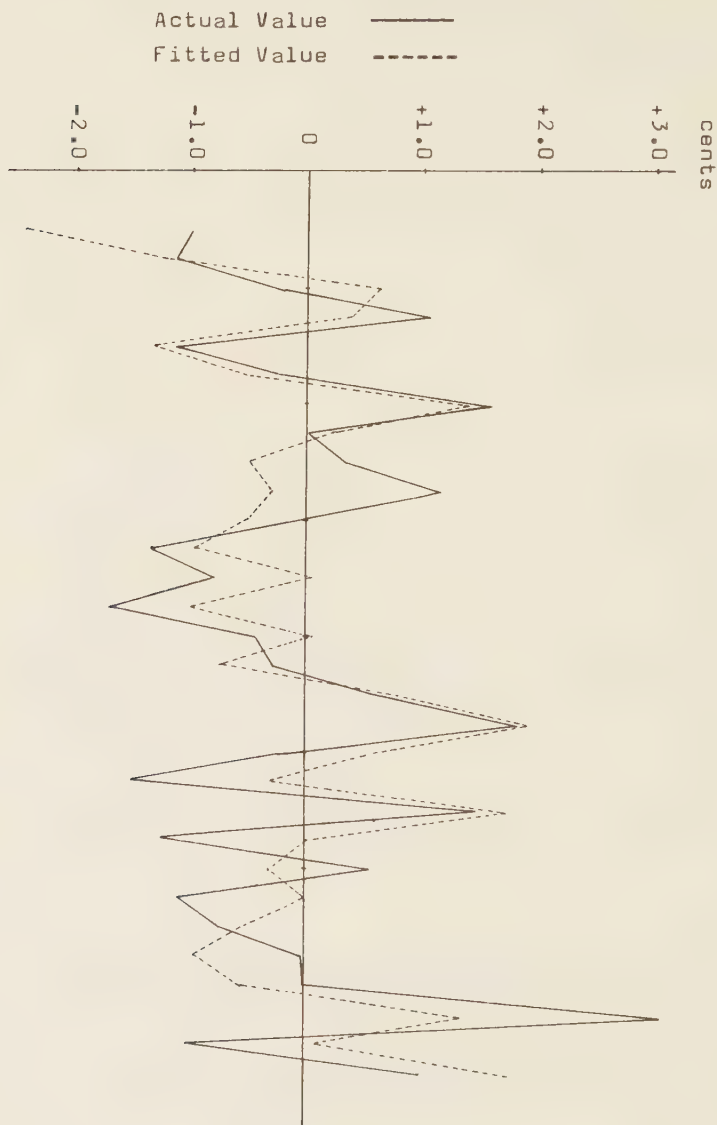
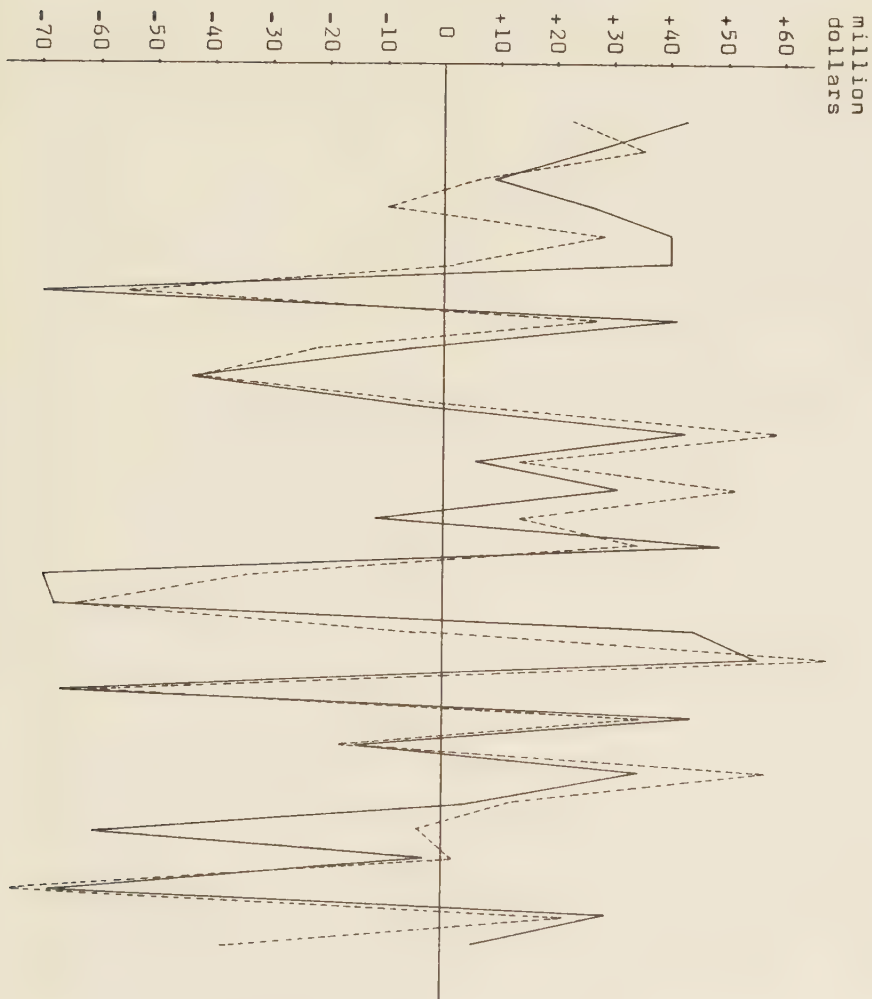


Figure (2)

Equation (9): Official Intervention Policy (1953-60)

Actual Value ———
Fitted Value - - - - -



in this study almost the same elasticity was also obtained in the case of the second floating rate period as in the fixed.¹ Whatever the true size may be, the statistical significance of the parameter seems to suggest that the stock of Canadian dollars was an important determinant of the U.S.-Canadian dollar rate in the 1950's.

Equation (8) also shows that the net long-term capital inflow to Canada was another determinant of the external value of the Canadian dollar in the 1950's. The parameter has the expected sign and is significantly different from zero. It suggests that a capital flow to Canada of 100 million dollars would have made the Canadian dollar appreciate by about one per cent per quarter. Although much attention has been concentrated on the role of short-term capital movements as a crucial determinant of the U.S.-Canadian rate, these results seem to suggest that the effect of long-term capital flows on the exchange rate through expectations was likewise a non-negligible factor.

We also notice that the short-term interest rate differential and the Canadian private sector's holdings of U.S. dollars have poor explanatory power. The estimated parameter of the former has the expected sign, but is statistically almost equal to zero; the parameter of the latter has the wrong sign and is also statistically insignificant.²

Let us turn to equation (9). It shows that the parameter of exchange rate change is statistically different from zero at the 99 per cent level of confidence with the expected sign. This suggests that the Canadian monetary authorities intervened in the foreign exchange market in response to each change in the spot rate from the preceding period; they purchased U.S. dollars when the Canadian dollar was appreciating and sold them when

1. For this point, see the empirical results of Model (II). The importance of Canadian monetary policy is pointed out by R.R. Rhomberg, op.cit. However, his empirical work is concerned mainly with the effect of a change in the Canadian (short-and long-term) interest rates on the U.S.-Canadian exchange rate, not with the effect of money stock on the exchange rate.

2. Another test will be presented to capture the effect of (Continued)

the Canadian dollar was depreciating. The size of the parameter shows that a one cent depreciation of the Canadian dollar from each preceding period would have led the monetary authorities to sell about 33 million U.S. dollars which represents about 1.85 per cent of the total stock of gold and U.S. dollars held by the monetary authorities in the first quarter of 1953 and 1.88 per cent in the fourth quarter of 1960. The smallness of the parameter, together with its negative sign, seem to suggest that, as is often pointed out, the main role of official intervention during the first floating rate in the 1950's was to reduce "excessive" short-run fluctuations in the Canadian dollar rather than to defend a particular target rate at the risk of attempting to resist a long-run trend movement dictated by market forces.

The parameter of price change, introduced to capture the effect of internal policy consideration on the official intervention, is not statistically significant, although it has the expected sign. This result suggests that price stabilization did not constitute a long-run policy consideration when decisions were made on the official interventions.

The major short-coming of the preceding empirical results is that they fail to capture the effects on the U.S.-Canadian rate of the short-term interest rate differential and the Canadian private sector's holdings of U.S. dollars. After several experiments, however, it turned out that the poor estimation results of the two variables are largely overcome if equation (4) is respecified in terms of levels of the variables with a slight modification of the expectation function: the new expectation variable is assumed to be a function of not only a change in the long-term capital inflow to Canada but also of the lagged spot rate. The underlying economic justification of the introduction of the lagged spot rate is that the movements in the U.S.-Canadian rate in each preceding period provide an important source of information for the prediction of the future spot rate. I now assume that the expected future spot rate is also a positive

the aforementioned two variables on the exchange rate.

function of the lagged spot rate.¹ Then, the expectation function will be respecified as:

$$\hat{e}_t = c_3 DK_t + c_4 e_{t-1} \quad (2-a)'$$

$$c_3 < 0, \quad c_4 > 0 \quad .$$

Rewriting equation (a) in the absolute value form and substituting (2-a)' into it, we have the following modified version of equation (4):

$$\begin{aligned} e_t = & f_1 (DR_t + R_{t-1} + N_t) + f_2 M_t^* + f_3 z_t + f_4 DK_t + f_5 e_{t-1} \\ & + f_6 S_1 + f_7 S_2 + f_8 S_3 + f_9 S_4 + u_{1t} \end{aligned} \quad (4)'$$

$$f_1 > 0, \quad f_2 < 0, \quad f_3 > 0, \quad f_4 < 0, \quad f_5 > 0 \quad .$$

Estimating equation (4)' and (5), we obtain the following estimation results:²

1. This assumption is equivalent to assuming an adaptive expectation hypothesis. The importance of lagged price as a determinant of expected future price is also pointed out by J.F. Muth from the point of view of rational expectation hypothesis. See J.F. Muth, "Rational Expectations and the Theory of Price Movements," *Econometrica* (July 1961), pp. 315-335. Note that a lagged exchange rate will also become an explanatory variable if the Koyck-Nerlove lag distribution is assumed.

2. DR_t and R_{t-1} enter equation (4)' since $R_t = DR_t + R_{t-1}$. As no modification is added to equation (5), our model in this case consists of two endogenous variables (e_t and DR_t) and eleven exogenous variables (e_{t-1} , R_{t-1} , N_t , M_t^* , z_t , DK_t , Dp_t and S_j ($j=1-4$)). De_t in equation (5) is treated as $De_t = e_t - e_{t-1}$ and the same parameter h_1 is imposed on them.

$$e_t = .00586 \begin{matrix} (DR_t + R_{t-1} + N_t) \\ (2.23) \end{matrix} - .00262 \begin{matrix} M_t^* \\ (2.23) \end{matrix} + .796 \begin{matrix} z_t \\ (2.11) \end{matrix} - .00980 \begin{matrix} DK_t \\ (3.86) \end{matrix} \\ + .726 \begin{matrix} e_{t-1} \\ (4.36) \end{matrix} + 16.1 \begin{matrix} S_1 \\ (0.98) \end{matrix} + 15.5 \begin{matrix} S_2 \\ (0.94) \end{matrix} + 14.2 \begin{matrix} S_3 \\ (0.86) \end{matrix} + 15.0 \begin{matrix} S_4 \\ (0.91) \end{matrix} \quad (8)'$$

$$D.W. = 2.14 \quad s = .91 \quad d.o.f. = 21$$

$$DR_t = - 36.8 \begin{matrix} De_t \\ (6.33) \end{matrix} - 2.93 \begin{matrix} Dp_t \\ (0.30) \end{matrix} \\ - 1.51 \begin{matrix} S_1 \\ (0.14) \end{matrix} + 28.4 \begin{matrix} S_2 \\ (2.26) \end{matrix} - 9.77 \begin{matrix} S_3 \\ (0.70) \end{matrix} - 3.54 \begin{matrix} S_4 \\ (0.33) \end{matrix} \quad (9)'$$

$$D.W. = 1.77 \quad s = 28.0 \quad d.o.f. = 24$$

Equation (8)' indicates that the parameters of M_t^* and z_t are statistically significant (at the 95 per cent level of confidence) with the expected signs. The parameter of M_t^* shows that an increase in the Canadian private sector's holdings of U.S. dollars by 100 million leads to an appreciation of the Canadian dollar by about 0.26 cents, which represents about 0.023 in terms of elasticity. We also notice that a 1 per cent increase in the U.S. short-term interest rate relative to the Canadian interest rate makes the Canadian dollar depreciate by about 0.8 cents. Although its statistical significance drops slightly compared to the previous result, the Canadian monetary base is still an important determinant of the U.S.-Canadian rate; similarly, the long-term capital flow to Canada is also statistically significant with the correct sign. Finally, the lagged spot rate has the expected sign and is statistically different from zero at the 99 per cent level of confidence.

Figure (1)' shows graphically the goodness of fit of the estimated equation (8)'. The equation seems to follow the actual values of the spot rate rather well.¹

1. The ordinary least squares estimates of equation (8)' and (9)' are as follows:

$$e_t = .00356 \begin{matrix} M_t \\ (1.45) \end{matrix} - .00169 \begin{matrix} M_t^* \\ (1.53) \end{matrix} + .658 \begin{matrix} z_t \\ (1.79) \end{matrix} - .00917 \begin{matrix} DK_t \\ (3.70) \end{matrix} + .747 \begin{matrix} e_{t-1} \\ (4.59) \end{matrix}$$

(Continued)

Figure (1)'

Equation (8)': U.S.-Canadian Exchange Rate (1953-60)

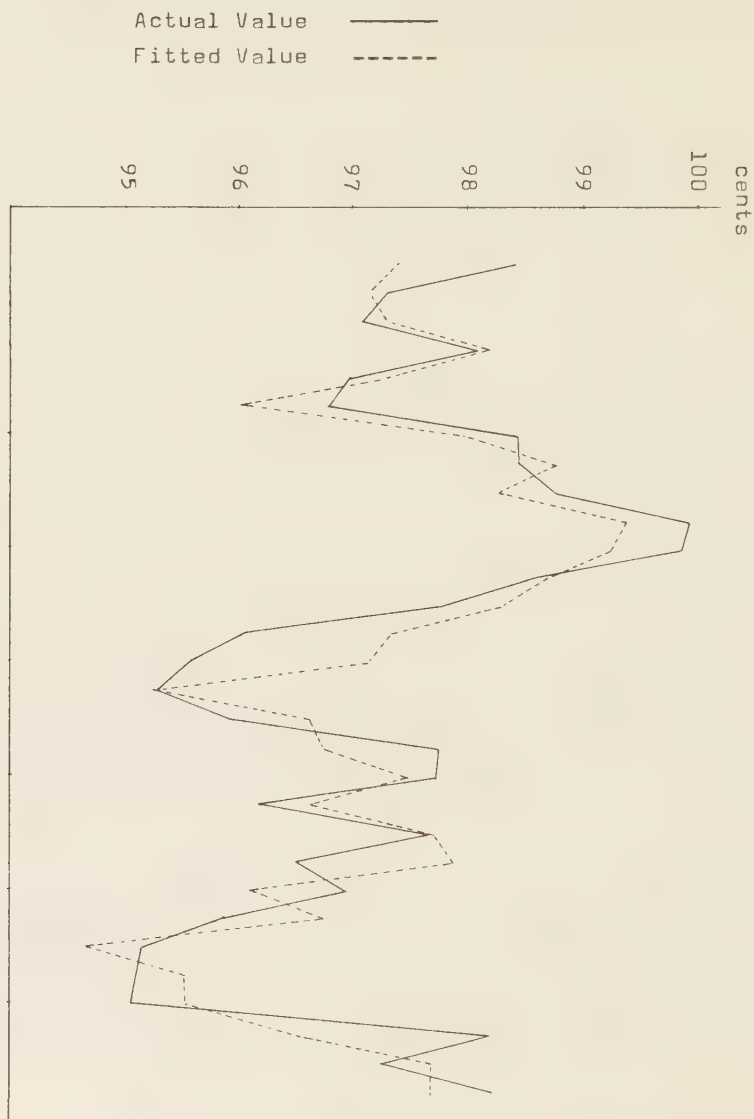
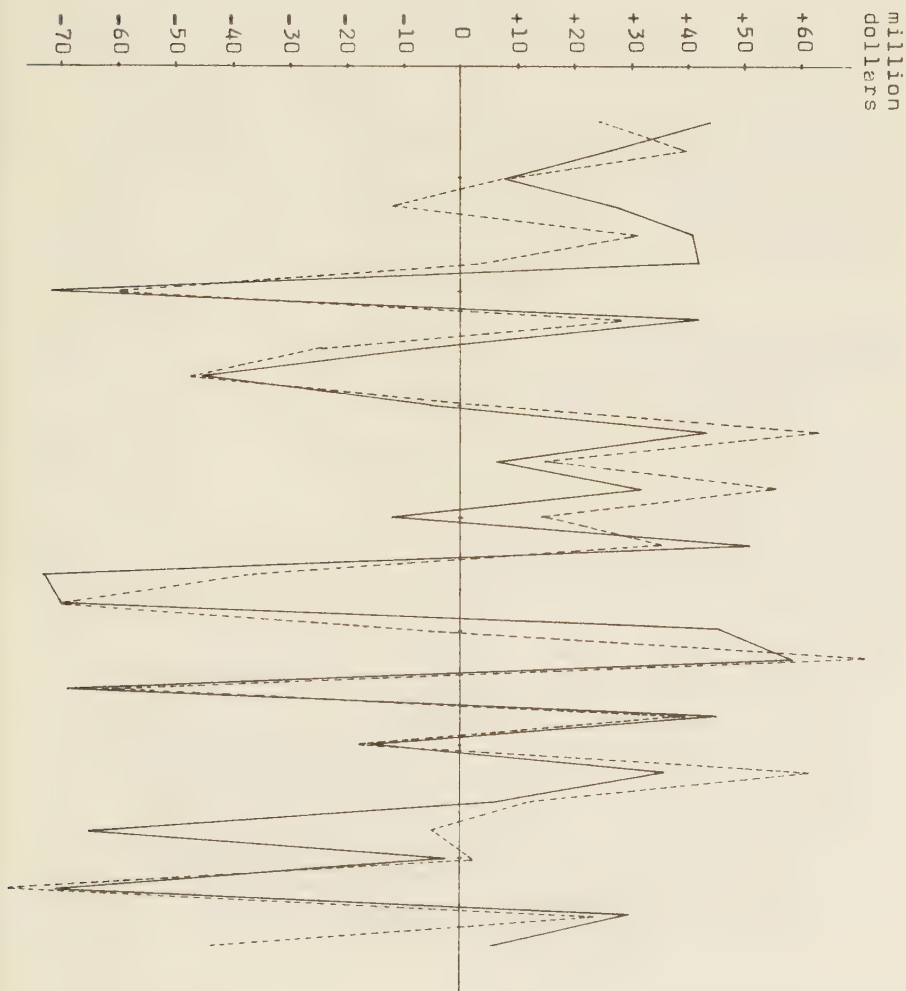


Figure (2)'

Equation (9)': Official Intervention Policy (1953-60)

Actual Value ———
Fitted Value - - - -



(b) Empirical Results in the Second Floating Rate Case

Model (II) was also estimated by the two stage least-squares estimation method. The sample period for the estimation is from the first quarter of 1971 to the fourth quarter of 1976. The types of data series used for the estimation are the same as those used for the estimation of Model (I) with the following exceptions. First, all data series except those of the U.S. balance of trade position are quarterly average figures, not end-of-quarter figures. Second, as a proxy for the Canadian private sector's holdings of U.S. dollars, those U.S. dollar assets held by the Chartered Banks against non-residents are used.¹ All data series are

$$+ 18.5 S_1 + 18.1 S_2 + 16.9 S_3 + 17.7 S_4 \\ (1.15) \quad (1.12) \quad (1.04) \quad (1.10)$$

$$R^2 = .68 \quad \text{D.W.} = 2.26 \quad s = .89 \quad \text{d.o.f.} = 21$$

$$\text{DR}_t = -29.8 \text{De}_t + .116 \text{Dp}_t \\ (6.67) \quad (0.01) \\ - 2.09 S_1 + 26.3 S_2 - 11.0 S_3 - 4.54 S_4 \\ (0.20) \quad (2.20) \quad (0.83) \quad (0.45)$$

$$R^2 = .69 \quad \text{D.W.} = 1.85 \quad s = 26.7 \quad \text{d.o.f.} = 24$$

1. The data used for the estimation are:

e_t : U.S.-Canadian spot rate; quarterly average noon rate as reported on transactions between banks in the foreign exchange market

R_t : Canadian official holdings of gold and U.S. dollars (in millions of Canadian dollars: quarterly average); Note that because of the main interest of this study in the actual net changes in the official holdings of gold and U.S. dollars through interventions in the foreign exchange market, changes in the official holdings of gold and U.S. dollars arising from pure accounting reasons such as revaluation of gold against the U.S. dollar and devaluation of the U.S. dollar in 1973 are excluded. The Canadian official holdings of S.D.R. and the reserve position in the I.M.F. are excluded from the definition of R_t mainly because they are not for intervention and do not lead to corresponding changes in the monetary base of Canada.

(Continued)

collected from Bank of Canada Review (1971-1976) except for those on the U.S. balance of trade, which are from Survey of Current Business.

Equations (10) and (11) are two stage least-squares estimates of Model (II), and Figures (3) and (4) graphically illustrate the goodness of fit of the estimated equations:¹

i_t : Canadian three-month treasury bill rate (quarterly average)

i_t^* : U.S. three-month treasury bill rate (quarterly average)

p_t : Canadian consumer price index (1971 = 100: quarterly average)

N_t : stock of the domestic source component of the monetary base (in millions of Canadian dollars: quarterly average); in calculating the data series from the monetary base and the official holdings of gold and dollars, changes in the domestic source component due to exchange rate changes are adjusted.

M_t^* : U.S. dollar assets held by the Chartered Banks against non-residents (in millions of Canadian dollars: quarterly average). Note that a part of non-residents includes the foreign agencies and branches of Canadian Chartered Banks.

BT_{t-1}^* : lagged U.S. balance of trade position (quarterly figures in million of U.S. dollars)

1. The ordinary least squares estimates of Model (II) are as follows:

$$De_t = .0123 DM_t - .000638 DM_t^* + .414 Dz_t + .000162 DBT_{t-1}^*$$

(5.33) (1.67) (1.89) (1.41)

$$+ 1.95 \frac{DUM}{(2.17)} - 2.45 S_1 - 3.83 S_2 - 2.41 S_3 - 2.83 S_4$$

(5.10) (5.10) (3.51) (3.76)

$$R^2 = .74 \quad D.W. = 2.24 \quad s = .790 \quad d.o.f. = 15$$

$$DR_t = -143.7 De_t - 70.27 Dp_t$$

(5.58) (2.37)

$$+ 188.9 S_1 + 137.3 S_2 + 152.3 S_3 + 136.7 S_4$$

(2.30) (1.38) (1.58) (1.61)

$$R^2 = .72 \quad D.W. = 1.19 \quad s = 144.8 \quad d.o.f. = 18$$

Figure (3)

Equation (10): U.S.-Canadian Exchange Rate (1971-76)

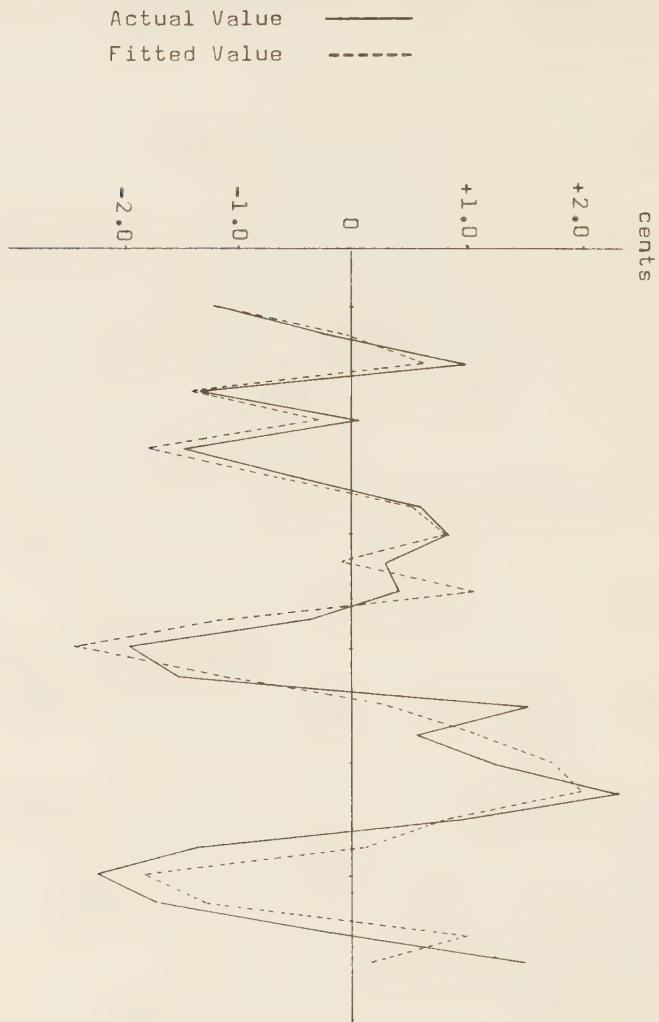


Figure (4)

Equation (11): Official Intervention Policy (1971-76)



$$De_t = .0146 (DR_t + DN_t) - .000732 DM_t^* + .481 Dz_t + .000150 DBT_{t-1}^* \\ (5.28) \quad (1.83) \quad (2.09) \quad (1.26) \\ + 2.00 \underline{DUM} - 2.71 S_1 - 4.49 S_2 - 2.99 S_3 - 3.43 S_4 \quad (10) \\ (2.15) \quad (5.20) \quad (5.14) \quad (3.77) \quad (3.99)$$

$$D.W. = 2.26 \quad s = .815 \quad d.o.f. = 15$$

$$DR_t = - 186.4 De_t - 66.41 Dp_t \\ (5.82) \quad (2.08) \\ + 159.2 S_1 + 110.9 S_2 + 165.0 S_3 + 125.5 S_4 \quad (11) \\ (1.79) \quad (1.03) \quad (1.59) \quad (1.38)$$

$$D.W. = 1.27 \quad s = 155. \quad d.o.f. = 18 \quad .$$

Equation (10) shows that all parameters (DM_t , DM_t^* , Dz_t and DBT_t^*) are statistically significant with the expected signs. The parameters of DM_t , DM_t^* and Dz_t are significantly different from zero at the 95 per cent level of confidence and the parameter of DBT_{t-1}^* at the 80 per cent level of confidence.

The stock of Canadian dollars is again an important determinant of the U.S.-Canadian dollar rate in the second floating rate period. The size of the estimated parameter is quite similar to the one that was obtained in the first floating rate case.¹ The parameter suggests that a \$ 100 million increase in the Canadian monetary base would have lead to a depreciation of the Canadian dollar by about 1.5 cents per quarter, which is equivalent to 1.10 in terms of elasticity.

The Canadian Chartered Banks' holdings of U.S. dollar assets are also statistically significant with the correct sign. The estimated value of the parameter, which is equal to 0.075 in terms of elasticity, suggests that the variable had a relatively small effect on the external value of the Canadian dollar, compared to the Canadian monetary base.

1. The size of the estimated parameter for $(DR_t + DN_t)$ in equation (10) is similar to that in equation (8) in terms of absolute value, not in terms of elasticity.

The short-term interest rate differential between the U.S. and Canada also seems to have played a non-negligible role in the determination of the exchange rate between the two countries. The parameter, which is statistically significant at the 95 per cent level of confidence with the correct sign, suggests that a 1 per cent increase in the U.S. short-term interest rate relative to the Canadian interest rate induced a depreciation of the Canadian dollar by about 0.48 cents per quarter, which is equal to an elasticity of 0.0076.

The lagged U.S. quarterly balance-of-trade position, which was introduced as a proxy for a determinant of expectations of the future U.S.-Canadian dollar rate, has the expected sign, although its statistical significance is rather lower than other explanatory variables mentioned above. The parameter suggest that an improvement in the U.S. balance of trade by \$ 1 billion would have led to a depreciation of the Canadian dollar by 1.5 cents per quarter during the sample period.

The parameter of the dummy variable introduced to capture the impact of the devaluation of the U.S. dollar in the First Quarter of 1973 on the Canadian dollar, is statistically significant at the 95 per cent level of confidence with a positive sign. It suggests that the devaluation created rather optimistic expectations on the strength of the U.S. dollar in the future and increased demand for U.S. dollars.

Equation (6) was also estimated adding a slight modification to the expectation variable: the net long-term capital inflows to Canada were again introduced with the assumption that they have a non-negligible impact on expectation formation about the future value of the U.S.-Canadian rate. As in the case of Model (I), it is assumed that an increase in the net long-term capital inflow to Canada leads the private sector to expect the Canadian dollar to appreciate in future periods, namely, the sign of its parameter is assumed to be negative. Estimating equation (6) with this modification, we obtain the following result:

$$De_t = .0142 (DR_t + DN_t) - .000928 DM_t^* + .441 Dz_t + .000207 DBT_{t-1}^*$$

(5.31) (2.23) (1.97) (1.69)

$$- .000648 \text{ DK}_t - 1.65 \frac{\text{DUM}}{(1.76)} \\ (1.30)$$

$$- 2.56 S_1 - 4.41 S_2 - 2.81 S_3 - 2.97 S_4 \quad (10)' \\ (4.99) \quad (5.23) \quad (3.65) \quad (3.36)$$

$$\text{D.W.} = 2.47 \quad s = .789 \quad \text{d.o.f.} = 14$$

The estimation result shows that the new variable (DK_t) has the expected sign and is statistically different from zero at the 80 per cent level of confidence.¹ Compared to the estimation result which was obtained for this variable in Model (I), however, one can see that the effect of the long-term capital inflow on the U.S.-Canadian dollar rate has become much weaker in the 1970's. The parameter suggests that an increase in the long-term capital inflow by 0.1 billion leads to an appreciation of the Canadian dollar by about 0.65 cents per quarter, equivalent to an elasticity of 0.42.

Let us turn to the intervention policy function given by equation (11). Equation (11) shows that the parameter for exchange rate change is significantly different from zero at the 99 per cent level of confidence with the correct sign. This suggests that the Canadian monetary authorities again reacted very actively to each change in the exchange rate from the preceding period. The negative sign of the estimated parameter suggests that the Canadian monetary authorities purchased U.S. dollars when the Canadian dollar was appreciating and sold them when the Canadian dollar was depreciating. The parameter also indicates that a 1 cent

1. The ordinary least squares estimate of equation (10)' is given by:

$$\text{De}_t = .0121 \text{ DM}_t - .000851 \text{ DM}_t^* + .381 \text{ Dz}_t + .000219 \text{ DBT}_{t-1}^* \\ (5.42) \quad (2.11) \quad (1.78) \quad (1.84)$$

$$- .000668 \text{ DK}_t + 1.59 \frac{\text{DUM}}{(1.75)} \\ (1.38)$$

$$- 2.33 S_1 - 3.83 S_3 - 2.30 S_3 - 2.43 S_4 \\ (4.90) \quad (5.25) \quad (3.42) \quad (3.09)$$

$$R^2 = .77 \quad \text{D.W.} = 2.47 \quad s = .767 \quad \text{d.o.f.} = 14$$

depreciation of the Canadian dollar per quarter induced the monetary authorities to sell U.S. dollars by about 180.0 million during the sample period. This represents 4.81 and 4.55 per cent of the official holdings of gold and U.S. dollars in the first quarter of 1971 and the first quarter of 1976, respectively, and is equivalent to 4.0 in terms of elasticity. In addition, the estimated parameter is almost five times larger in absolute value than the one which was obtained in the first floating rate period.¹ If comparison is made in terms of elasticity, the coefficient in the second floating rate period is about 2.25 times larger than the one in the first floating rate period. From these results, we could infer that the Canadian floating rate in the first half of the 1970's had been a heavily controlled rate rather than a freely floating rate.

The parameter of price change is also statistically significant at the 95 per cent level of confidence with the expected sign. This result suggests that the internal consideration of price stability constituted an important factor affecting intervention policy during the sample period. The parameter indicates that a 1 per cent increase in the consumer price index (base year 1971 = 100) tended to reduce official intervention in the foreign exchange market by US\$ 65 million per quarter during the sample period, which represents 1.74 in terms of average elasticity.

(4) Concluding Remarks

The purpose of this chapter was to test the portfolio approach to the exchange rate, using the quarterly model for the U.S.-Canadian dollar rate in the 1950's and the 1970's (more precisely, 1971-76). Much interest centered on the effects of monetary factors, in particular, the stock of Canadian dollars upon the U.S.-Canadian dollar rate during the sample periods. In conclusion I would like to note four implications arising

1. For this comparison, see the estimated parameters of equations (9) and (9)'. The discussion on the size of the official intervention in the 1950's, see pages 164-165.

out of the present empirical work.

First, that the stock of Canadian dollars represented by the Canadian monetary base was a major determinant of the U.S.-Canadian rate during the two floating rate periods seems to support one of the basic theoretical propositions made by the portfolio approach. We have seen that the average elasticities of the exchange rate with respect to the Canadian money supply were about 0.39 (0.15 in the case of equation (8)') in the 1950's and 1.10 in the 1970's. This suggests that the effect of the Canadian money supply on the exchange rate grew in significance from the 1950's to the 1970's. The high elasticity obtained in the case of the second floating rate period implies that the exchange rate may overshoot the long-run equilibrium rate in the short-run. This implication, however, should be explained with caution because of the lack of lag adjustment of the exchange rate in the estimated equation.¹

Second, the empirical results also show that the Canadian Chartered Banks' holdings of U.S. dollar assets and the short-term interest rate differential between U.S. and Canada, which constitute other monetary variables influencing exchange rate determination, were important determinants of the U.S.-Canadian rate during the sample periods. However, their effects on the exchange rate are small compared with the effect of the Canadian money supply: the average elasticity of the U.S.-Canadian rate with respect to the Canadian holdings of U.S. dollar assets was about 0.023 (according to equation (8)') in the 1950's and 0.076 in the 1970's, while the average elasticity of the U.S.-Canadian dollar rate with respect to the short-term interest rate differential was about 0.005 (according to equation (8)') in the 1950's and 0.008 in the 1970's.²

1. The lagged exchange rate was dropped from equation (10) because its parameter had a negative sign with a low statistical significance.

2. The effect of the short-term interest rate differential on the U.S.-Canadian rate in the 1950's obtained from the empirical work is similar to the one found by R.R. Rhomberg. His empirical work indicates that "a short-term interest rate differential of 1 per cent per annum tends to raise the Canadian exchange rate by perhaps as much as $\frac{1}{2}$ to 1 cent." See R.R. Rhomberg, *op. cit.* pp.446 and equation (8)' in this chapter.

Third, the empirical results indicate that the net long-term capital inflow to Canada and the lagged U.S. balance-of-trade position, which were introduced as proxies for the expectation variable, have expected correlations with the U.S.-Canadian dollar rate. The results show that the former was an important explanatory variable of the exchange rate not only in the 1950's but also in the 1970's.

Finally, the empirical results suggest that the Canadian monetary authorities, reacting to a change in each U.S.-Canadian dollar rate from the preceding period, intervened in the foreign exchange market more actively in the second floating rate period than the first. The size of official intervention in the 1970's is about five times larger in absolute value, two times larger in terms of elasticity, and two and a half times larger in terms of the ratio of the average size of intervention to the average official holdings of gold and U.S. dollars than that in the 1950's. This seems to suggest that the remarkable stability of the Canadian dollar in the 1970's depended considerably upon official interventions by the monetary authorities.

CONCLUDING REMARKS

The aim of this paper was to discuss the three problems which arise from the recent development of the portfolio approach to flexible exchange rates:

(i) the clarification of the essence of the portfolio approach and the specification of the asset equilibrium condition for exchange rate determination;

(ii) the analysis of the macro-economic implication of the portfolio approach to exchange rate determination, in particular the analysis of the dynamic impact of domestic monetary policy on the exchange rate and the balance of trade;

(iii) the empirical test of the effects of monetary factors on the exchange rate.

As for the first problem, it was argued that the portfolio approach is a direct development of the monetary approach to the balance of payments and that the determination of the exchange rate can be formulated in terms of portfolio equilibrium between domestic and foreign monetary assets rather than in terms of equality between demand for and supply of foreign exchange. The demand functions for domestic and foreign monetary assets were derived under simple assumptions by applying the mean-variance approach to portfolio choice, and an asset equilibrium condition for exchange rate determination was presented. In deriving the asset equilibrium condition, emphasis was put not only on investment demand but also on transactions demand for domestic and foreign monetary assets. The asset equilibrium showed that the equilibrium exchange rate depends upon a number of variables such as the stocks of domestic and foreign monetary assets, the expected future exchange rate, the domestic and foreign rates of interest and prices, etc.

The second problem was discussed by integrating the asset view of exchange rate determination into a simple macro model. Interest centered on the dynamic impact of domestic monetary policy on the exchange rate and

the balance of trade. It was shown that (i) the short-run equilibrium exchange rate does not necessarily overshoot the long-run equilibrium rate and (ii) the balance of trade becomes deficit in the short-run but turns into a surplus during adjustment process and reaches equilibrium in the long-run. It was noted that three assumptions are crucial for these results: (i) expectations about the future exchange rate follow the adaptive expectation model; (ii) a change in domestic price affects assets diversification by inducing a change in transactions demand for domestic monetary assets; and (iii) the goods market is cleared instantaneously.¹

Finally, an empirical test of the portfolio view of exchange rate determination was made by applying a simple econometric model to the Canadian floating rates in the 1950's and the 1970's. The empirical test did not reject the importance of the roles of monetary factors, in particular the quantity of Canadian dollars, in determining the U.S.-Canadian exchange rate during the two sample periods.

In closing the present study, it will not be irrelevant to point out some directions in which further work should be done.

First, in the discussion of the dynamic impact of macro-economic policy and international (real and monetary) disturbances, two exemptions, which may be considered to be rather strong, were made: (i) expectations about the future exchange rate is based upon the adaptive expectation hypothesis, and (ii) the goods market adjusts instantaneously as does the asset market. Because of the importance of the role of expectations in the portfolio view of exchange rate determination, it will be interesting to re-examine the results obtained in this paper under alternative expectation hypotheses. For example, what results will be obtained if the adaptive expectation hypothesis is replaced by the rational expectation hypothesis? The relaxation of the second assumption will also be theoretically important. If allowance is made for difference in the speed of adjustment between the goods and the asset markets (for example, the

1. It should be noted that this condition was not particularly emphasized in chapter 5.

former adjusts more slowly than the latter), it is quite likely that the conclusions in chapter 5 are modified substantially, although this requires a more complicated theoretical framework for short-run dynamics of price and output.

Second, the empirical study presented in this paper was confined only to the case of U.S.-Canadian exchange rate determination. To judge the relevancy of the portfolio approach, we need to do the same type of test for other exchange rates. In doing so, we shall need to pay more attention to the role of relative price between domestic and foreign countries in exchange rate determination, which was not fully discussed in this empirical study. It should also be noted that the empirical study was based upon a quite simple expectation hypothesis. Again, taking into account the importance of the role of expectations on the future exchange rate, we shall need to do more careful tests of the expectation formation and to see what type of expectation hypothesis is mostly supported by empirical evidence. The introduction of wider flexibility since 1973 seems to provide us with sufficient statistical opportunity for these tests.

BIBLIOGRAPHY

- V. Argy and M.G. Porter, "The Forward Exchange Market and the Effects of Effects of Domestic and External Disturbances under Alternative Exchange Rate System," I.M.F. Staff Papers, 19, No. 3 (November 1972), pp. 503-532.
- B. Balassa, "The Purchasing Power Parity Doctrine: A Reappraisal," Journal of Political Economy, Vol. LXXII, No. 6 (December 1964), pp. 584-596.
- H.H. Binhammer, "Canada's Foreign Exchange Problems: A Review," Kyklos, No. 4 (1964), pp. 636-652.
- S.W. Black, "International Money Markets and Flexible Exchange Rates," Princeton Studies in International Finance, No. 32, International Finance Section, Dept. of Economics (Princeton University, 1973).
- W.H. Branson, "Macroeconomic Equilibrium with Portfolio Balance in Open Economies," Institute for International Economic Studies, Stockholm, Seminar Paper No. 22 (November, 1972).
- A.J. Brown, "Trade Balance and Exchange Stability," Oxford Economic Papers, No. VI (1942), pp. 57-75.
- G. Cassel, Money and Foreign Exchange After 1919, London, Macmillan, 1930.
- C.N. Chen, "Diversified Currency Holdings and Flexible Exchange Rates," Quarterly Journal of Economics, Vol. LXXXVII, No. 1 (February 1973), pp. 96-111.
- R.N. Cooper, "Macro-Economic Policy Adjustment in Interdependent Economies," Quarterly Journal of Economics, Vol. 83, No. 1 (February 1969), pp. 1-24.
- T.J. Courchene and A.K. Kelly, "Money Supply and Money Demand: An Econometric Analysis for Canada," Journal of Money, Credit and Banking, Vol. III, No. 2 (May 1971).
- R. Dornbush, "Real and Monetary Aspects of the Effects of Exchange Rate Change," Discussion Paper No. 72-16, Dept. of Economics, University of Rochester, (1972).
- , "Flexible Exchange Rates, Capital Mobility and Macroeconomic Equilibrium," Discussion Paper, No. 74-76, Dept. of Economics, University of Rochester (April 1974).

- , "The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy," Presented to the Seminar on Flexible Exchange Rates and Stabilization Policy, Saltsjobaden, Stockholm (August 1975). (In what follows the seminar will be referred to as the Stockholm Seminar.)
- , "Exchange Rate Dynamics," Working Paper, No. 167, Dept. of Economics of Massachusetts Institute of Technology (November 1975).
- M. Fleming, "Domestic Financial Policies under Fixed and under Floating Exchange Rates," I.M.F. Staff Papers, Vol. 9, No. 3 (1959), pp. 369-379.
- J.E. Floyd, "International Capital Movements and Monetary Equilibrium," American Economic Review, Vol. 59, No. 4 (September 1969), pp. 472-492.
- , "Monetary and Fiscal Policy in a World of Capital Mobility," Review of Economic Studies, Vol. 36, No. 4 (October 1969), pp. 503-519.
- J.A. Frenkel, "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," Presented at the Stockholm Seminar (August 1975).
- J.A. Frenkel and C.A. Rodriguez, "Portfolio Approach and the Balance of Payments: A Monetary Approach," American Economic Review, Vol. 65, No. 4 (September 1975), pp. 674-687.
- M. Friedman, "The Case for Flexible Exchange Rates," in M. Friedman, Essays in Positive Economics, (Chicago: University of Chicago Press, 1953).
- , "The Quantity Theory of Money, A Restatement," in M. Friedman, (ed.), Studies in the Quantity Theory of Money, (Chicago: University of Chicago Press, 1956), pp. 3-21.
- H. Genberg and H. Kierzkowski, "Employment and Price Fluctuations under Flexible Exchange Rates," The Graduate Institute of International Studies, Geneva (May 1975).
- H.G. Grubel, Forward Exchange, Speculation and the International Flow of Capital, Stanford University Press (Stanford, 1966).

- , "Internationally Diversified Portfolios: Welfare Gains and Capital Flows," American Economic Review, Vol. 58, No. 4 (December 1968), pp. 1299-1314.
- G. Haberler, The Theory of International Trade (London, William Hodge and Co., 1936).
- , "The Market for Foreign Exchange and the Stability of the Balance of Payments: A Theoretical Analysis," Kyklos, Vol. 3 (1949), pp. 193-218.
- A.C. Harberger, "Currency Depreciation, Income and the Balance of Trade," Journal of Political Economy, Vol. 58 (1950), pp. 47-60.
- J.R. Hicks, Value and Capital (Clarendon Press, 1939).
- A.O. Hirschman, "Devaluation and Trade Balance: A Note," Review of Economics and Statistics, Vol. 31 (1949), pp. 50-53.
- H.G. Johnson, "The Transfer Problem and Exchange Stability," Journal of Political Economy, Vol. LXIV, No. 3 (June 1956), pp. 212-215.
- , "Towards A General Theory of the Balance of Payments," in H.G. Johnson, International Trade and Economic Growth (London 1958), Chapter 6, pp. 153-168.
- , "The Monetary Approach to Balance-of-Payments Theory," in M.B. Connolly and A.K. Swoboda (eds), International Trade and Money (London: Allen and Unwin, 1972), Chapter 2, pp. 206-224.
- , "The Case for Flexible Exchange Rates, 1969," in H.G. Johnson, Further Essays in Monetary Economics (London George Allen and Unwin, 1972), Chapter 8, pp. 198-222.
- R.W. Jones, "Depreciation and the Dampening Effect of Income Changes," Review of Economics and Statistics, Vol. 42 (1960), pp. 74-80.
- , "Comment: 'Portfolio Balance and International Payments Adjustment'," in R.A. Mundell and A.K. Swoboda (eds), Monetary Problems of the International Economy (Chicago: University of Chicago Press, 1969).
- M.C. Kemp, "The Rate of Exchange, the Terms of Trade and the Balance of Payments in Fully Employed Economies," International Economic Review, III (1962), pp. 314-327.

-----, The Pure Theory of International Trade and Investment
(Prentice-Hall, 1969).

J. Kesselman, "The Role of Speculation in Forward-Rate Determination:
The Canadian Flexible Dollar 1953-60," Canadian Journal of
Economics, Vol. 4, No. 3 (August 1971), pp. 279-298.

R. Komiya, "Monetary Assumptions, Currency Depreciation and the Balance
of Trade," Economic Studies Quarterly, Vol. 17, No. 2
(December 1966), pp. 9-23.

-----, "Economic Growth and the Balance of Payments: A Monetary
Approach," Journal of Political Economy, Vol. 77, No. 1
(January/February 1969), pp. 35-48.

P.J.K. Kouri, "The Exchange Rate and the Balance of Payments in the Short-
run and in the Long-run," Presented at the Stockholm Seminar
(August 1975).

A.O. Krueger, "The Impact of Alternative Policies under Varying Exchange
Rates," Quarterly Journal of Economics, Vol. 79, No. 2 (May
1965), pp. 195-208.

S. Laursen and L.A. Metzler, "Flexible Exchange Rates and the Theory of
Employment," Review of Economics and Statistics, Vol. 32
(February 1950), pp. 281-299.

C.H. Lee, "A Stock-Adjustment Analysis of Capital Movements: The United
States-Canadian Case," Journal of Political Economy, Vol. 77,
No. 4 (July/August 1969), pp. 512-523.

F. Machlup, "The Theory of Foreign Exchanges," in H.S. Ellis and L.A.
Metzler (eds), Readings in the Theory of International Trade
(Blakiston: Philadelphia, 1949).

H. Markowitz, Portfolio Selection: Efficient Diversification of Invest-
ments (New York: Wiley, 1959).

J.E. Meade, The Theory of International Economic Policy, Vol. 1, The
Balance of Payments (London, 1951).

L.A. Metzler, "The Theory of International Trade," A Survey of Contemporary
Economics (Ellis ed., Blakiston, 1949).

-----, "Wealth, Saving and the Rate of Interest," Journal of Political
Economy, Vol. 59 (April 1951).

- R.I. McKinnon and W.E. Oates, "The Implications of International Economic Integration for Monetary, Fiscal, and Exchange-rate Policy," Princeton Studies in International Finance, No. 16, International Finance Section (Princeton University, 1966).
- R.I. McKinnon, "Portfolio Balance and International Payments Adjustment," in R.A. Mundell and A.K. Swoboda (eds), Monetary Problems of the International Economy (Chicago: University of Chicago Press, 1969).
- M. Michaely, "Relative Prices and Income Absorption Approaches to Devaluation," American Economic Review, Vol. 50 (1960), pp. 144-147.
- R.A. Mundell, "Barter Theory and the Monetary Mechanism of Adjustment," in R.A. Mundell, International Economics (New York 1968), Chapter 8, pp. 111-133.
- , "The Monetary Dynamics of International Adjustment under Fixed and Flexible Exchange Rate," Quarterly Journal of Economics, Vol. 74, No. 2 (May 1960), pp. 227-257.
- , "The International Disequilibrium System," Kyklos, Vol. 14, No. 2 (1961), pp. 153-172.
- , "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," Canadian Journal of Economics and Political Science, Vol. 29, No. 4 (November 1963), pp. 475-485.
- , "Flexible Exchange Rates and Employment Policy," Canadian Journal of Economics and Political Science, Vol. 27 (November 1961), pp. 509-517.
- , Monetary Theory: Inflation, Interest, and Growth in the World Economy (California Good Year, 1971).
- M. Mussa, "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a Regime of Controlled Floating," Presented at the Stockholm Seminar (August 1975).
- , "Real and Monetary Factors in a Dynamic Theory of Foreign Exchange," International Monetary Research Programme, London School of Economics and Political Science (June 1976).
- , "A Monetary Approach to Balance-of-Payments Analysis," Journal of Money, Credit and Banking, Vol. 6, No. 3 (August 1974), pp. 333-350.

- J.F. Muth, "Rational Expectations and the Theory of Price Movements," Econometrica (July 1961), pp. 315-335.
- J. Myhrman, "Experiences of Flexible Exchange Rates in Earlier Periods: Theories, Evidence and a New View," Presented at the Stockholm Seminar (August 1975).
- W.E. Oates, "Budget Balance and Equilibrium Income: A Comment on the Efficacy of Fiscal and Monetary Policy in an Open Economy," Journal of Finance, Vol. 21, No. 4 (September 1966), pp.489-498.
- G.H. Orcutt, "Measurement of Price Elasticities in International Trade," Review of Economics and Statistics, Vol. 32, No. 2 (May 1950), pp. 117-132.
- I.F. Pearce, "A Note on Mr. Spraos' Paper," Economica, Vol. N.S. 22 (1955), pp. 147-151.
- B. Pesek and T. Saving, "Monetary Policy, Taxes, and the Rate of Interest," Journal of Political Economy (April, 1963).
- J. Pippenger, "The Canadian Experiences with Flexible Exchange Rates," American Economic Review Proceedings, Vol. 58 (May 1967), pp. 545-560.
- A.F.W. Plumptre, "Exchange Rate Policy: Experience with Canada's Floating Rate," Princeton Essays in International Finance, No. 81, International Finance Section, Dept. of Economics (Princeton University, 1970).
- G.L. Reuber, "The Objectives of Canadian Monetary Policy, 1949-61: Empirical 'Trade-Offs' and the Reaction Function of the Authorities," Journal of Political Economy, Vol. 72, No. 2 (August 1964).
- R.R. Rhomberg, "Canada's Foreign Exchange Market," I.M.F. Staff Papers, Vol. 7, No. 3 (April 1960), pp. 439-456.
- , "A Model of the Canadian Economy under Fixed and Fluctuating Exchange Rates," Journal of Political Economy, Vol. 72 (February 1964).
- J. Robinson, "The Foreign Exchanges," in J. Robinson, Essays in the Theory of Employment, Part 3 (New York, 1937).

- R.W. Roll and B.H. Solnik, "The Foreign Exchange Market and Transmission of Economic Disturbances," Conference on the Monetary Mechanism in Open Economies, Helsinki, Finland (August 1975).
- E. Sohmen, Flexible Exchange Rates, 2nd Edition (University of Chicago Press, 1969).
- , "Fiscal and Monetary Policies under Alternative Exchange Rate Systems," Quarterly Journal of Economics, Vol. 81 (August 1969), pp. 515-523.
- J. Spraos, "Consumers' Behavior and the Conditions for Exchange Stability," Economica, Vol. N.S. 22 (1955), pp. 137-147.
- H.R. Stoll, "An Empirical Study of the Forward Exchange Market under Fixed and Flexible Exchange Rate System," Canadian Journal of Economics, Vol. 1, No. 1 (February 1968), pp. 56-64.
- A.K. Swoboda, "Monetary Policy under Fixed Exchange Rates: Effectiveness, the Speed of Adjustment and Proper Use," Economica (May 1973), pp. 205-223.
- , "Monetary Approaches to Balance-of-Payments Theory: Framework for a Survey," The Graduate Institute of International Studies (Geneva, 1974).
- , "The Eurodollar Market: An Interpretation," Essays in International Finance (Princeton University, 1968).
- J. Tobin, "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies, Vol. 25, No. 67 (February 1958), pp. 65-86.
- , "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit and Banking, Vol. 1 (1969), pp. 15-29.
- S.C. Tsiang, "The Theory of Forward Exchange and Effects of Government Intervention in the Forward Exchange Market," I.M.F. Staff Papers, Vol. 7 (April 1959), pp. 75-100.
- , "The Role of Money in Trade-Balance Stability: Synthesis of the Elasticity and Absorption Approaches," American Economic Review, Vol. 51 (1961), pp. 912-936.
- T.D. Willett and F. Forte, "Interest Rate Policy and External Balance," Quarterly Journal of Economics, Vol. 83, No. 2 (May 1969).

L.B. Yeager, "A Rehabilitation of Purchasing-Power Parity," Journal of Political Economy, Vol. 66 (December 1958), pp. 516-530.

-----, International Monetary Relations: Theory, History, and Policy, 2nd Edition (New York: Harper and Row Publishers, 1976), Chapter 26, "Canada's Fluctuating Exchanging Rate," pp. 543-565.

Bank of Canada, Statistical Summary, 1950-1961.

-----, The Bank of Canada Review, 1970-1976.

International Monetary Fund, International Financial Statistic, 1953-1960 and 1970-1976.

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